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– PUBLISHED SINCE 1915 BY THE AMERICAN RADIO RELAY LEAGUE INC –

FEBRUARY 1928

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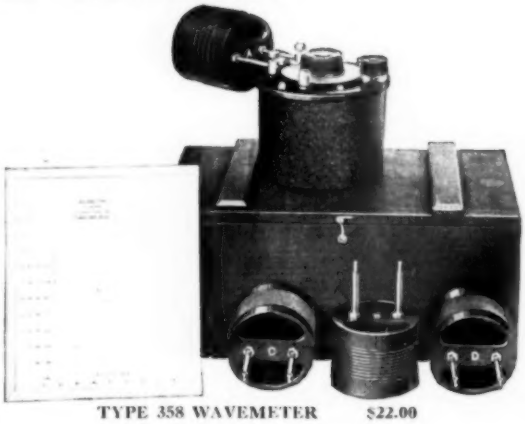

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# GENERAL RADIO Co

30 State St., Cambridge, Mass. 274 Brannan St., San Francisco, Calif.

# QST

## The Official Organ of the A·R·R·L

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# The American Radio Relay League

The American Radio Relay League, Inc., is a non-commercial association of radio amateurs, bonded for the promotion of interest in amateur radio communication and experimentation, for the relaying of messages by radio, for the advancement of the radio art and of the public welfare, for the representation of the radio amateur in legislative matters, and for the maintenance of fraternalism and a high standard of conduct.

It is an incorporated association without capital stock, chartered under the laws of Connecticut. Its affairs are governed by a Board of Directors, elected every two years by the general membership. The officers are elected or appointed by the Directors. The League is non-commercial and no one commercially engaged in the manufacture, sale or rental of radio apparatus is eligible to membership on its board.

"Of, by and for the amateur", it numbers within its ranks practically every worth-while amateur in the world and has a history of glorious achievement as the standard-bearer in amateur affairs.

Inquiries regarding membership are solicited. A bona fide interest in amateur radio is the only essential qualification; ownership of a transmitting station and knowledge of the code are not prerequisite. Correspondence should be addressed to the Secretary.

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# EDITORIALS

AS the weeks roll by it is possible to look back upon the International Radiotelegraph Conference with a bit of perspective. We didn't get as great privileges as we wanted or as great as we think we were entitled to, but we got all that we were able to, with loyal and powerful assistance from our Government. Some of our members do not understand how the attitude of foreign governments could have any effect upon what our Government does for us. They forget that radio is an international affair and that it has been agreed that radio is to be governed by international treaties. Every nation of course has always been free to grant the right to use wavelengths and low power that do not get outside of the country of origin—and this was the condition under which we amateurs operated our 200 meter spark stations in the old days. But the nations have always agreed that when wavelengths could interfere internationally, they should be the subject of an international agreement. Twenty years ago they made such a treaty, and agreed that they would have meetings every five years thereafter to bring things up to date. In 1912 the nations met in London and adopted what has been known as the London Convention of 1912. Then came the War and it was impossible to have the next meeting in 1917, and post-war difficulties caused a further postponement, so that it was fifteen years before the next conference was held—the one this winter in Washington.

In the meantime amateur radio grew up in the world, and the various nations recognized it and gave it varying privileges in accordance with their inclinations. All of these privileges were considered experimental and tentative, as they had never been internationally agreed to by the other nations, which of course was essential because amateur short waves are international in effect. When the nations met in Washington this winter the United States wanted to keep all of the present privileges for its amateurs and tried to get the same privileges for amateurs everywhere—as there had to be an international agreement on it. Unfortunately most of the other countries were unwilling to give amateur radio more than limited privileges, and some of them didn't want to make any provisions for amateur at all. Our Government stood up most stoutly for us, in a fashion that was very pleasing, and did its very best in arguing for us. Finally a compromise was reached—the figures reported in our January issue—which give us much more than most nations wanted us to have but less than we wanted and less than our Government wanted us to have. Our Government did not feel, however, that it could refuse to play ball with all of these other countries, because there was much more at stake than just the matter of amateurs, and it was highly necessary for radio as a whole to have the benefit of an international agreement. No nation got what it wanted at Washington—every one of them had to take into consideration the desires of all of the others and make compromises. Our Government wishes that we had got more but it was impossible to get international agreement therefor, and obviously there is no use talking about anything that cannot be internationally agreed to because any deviation from the international plan would disrupt all of the services of all of the other countries.

Although we amateurs in this country perhaps have not fully understood that our wavelength privileges of the past have been only temporary in character, the licenses of amateurs in many other countries have specifically stated that they were subject to amendment by the next International Conference. Never before was there an international agreement on amateurs. That is why this Conference was so important an event in the lives of us amateurs; that is why our League officials studied it so diligently the past year, and why we talked so much about it throughout 1927 in *QST*. Anything might have happened. It is chiefly when we consider what a great danger this International Convention offered to amateur radio that we may be pleased with the results of it. As it is, we have achieved an international status and are written into the treaty. Although the privileges we now get definitely are considerably less in some respects than we previously had tentatively, we shall be able to get along all right. The League accepts the results—its Board so votes.

The League will make no effort to secure from the United States Senate a reservation on behalf of amateur radio when the treaty comes up for Senate ratification. We do not believe it would be possible to get a reservation. We do not believe that it is necessary. And we are sure that the effort, successful or unsuccessful, would bring us into the

greatest disrepute with our own Government officials. And the effort if successful would cause us to be the most detested group in radio anywhere under the sun, because of the thoroughness with which our activities would then demolish most of the plans for international coöperation arrived at so laboriously at Washington. Individual amateurs of course are privileged to protest to their Senators if they are convinced they must, but that cannot be the League position and the League urges against the effort as being futile, unnecessary, and unwise.

WHEN we speak in *QST* of the united opposition against the amateur at the Washington Conference it must be understood that we are speaking of the opposition offered by those nations which directly participated in the discussions concerning the amateur, particularly the "teacupping" sessions where wavelengths were discussed. Many nations did not get to participate in these preliminary discussions; some that did not were friendly to us, and in fact we had no opportunity at all to learn the attitudes of some of the nations. We have listed as friendly and helpful the delegations of the United States, Australia, Italy, New Zealand, and the efforts of Commander Edwards of Canada. In the group who actively carried on the opposition to the amateur we have Great Britain, Germany, Netherlands, Japan, Belgium, and Major Steel of Canada. France must be listed as mixed but more opposed than friendly. There are several nations that were inactive but whose delegates we believe would probably have been friendly to the amateur if they had had an opportunity to express themselves in these early discussions: South Africa, Argentina, British India, Irish Free State, Hungary and Switzerland. The listing of Switzerland under this head may come as a surprise when our readers remember that it was this country which originally gave voice in the Book of Proposals to the most stringent anti-amateur suggestions. It seems now that these Swiss proposals were dictated chiefly by a fear for the safety of the State's monopoly on communications and because of a lack of proper appreciation of amateur work, for the Swiss delegate, Mr. Ernest Nussbaum, turned out to be a very fair-minded man, quite interested in learning more about amateur radio. He asked for and received from us much information and data on the organization of amateur radio in this country and internationally, displayed great interest in the progress of amateur radio and the regulations under which it operated in different countries, and promised that when he returned home he would devote efforts to the advancement of Swiss amateur radio. He will have ample opportunity to extend encouragement to it, for he is chief of the government bureau of telegraphy and communications.

Finally, we have some definite friends of the amateur to list, who, unfortunately, were without opportunity to participate in the amateur wavelength discussion because of the accidental informal composition of those meetings, but who undoubtedly would have lent a vote to support the amateur if they had had the chance. Amongst these are Dr. Otto Kucera, chief delegate of Czechoslovakia; Mr. Constantin Barbulescu, the delegate of Roumania; and Major Jose Sastre, one of the leading delegates from Spain, whose very kind support of the amateur position had been assured before his departure for this country by Sr. Miguel Moya, EAR1, the president of the Spanish Section of the I.A.R.U. Senor Moya is to be thanked and congratulated for his enterprise and success in this respect. The friendly interest of Spain in the amateur is of additional interest when it is remembered that the next International Radiotelegraph Conference is to be held in Madrid in 1932.

A TERRIFIC little tempest has been kicked up about the recent change in amateur phone regulations, particularly the rescinding of the privilege to operate phone on the lower 100 kilocycles of the so-called 80-meter band. Some disappointed phone amateurs have gone so far as to claim that the A.R.R.L. recommendations to the Federal Radio Commission were the unauthorized personal views of an individual or two at Headquarters, launched as part of a carefully concocted plan of persecution of the phone, aiming to do away with it. Fortunately some sanity of viewpoint has now returned and it should be possible to examine the question dispassionately.

The new amateur phone regulations are based upon recommendations of the League and, with the single exception that the Federal Radio Commission reserved 190 to 200 meters as a buffer band against interference with broadcast reception, they follow the League's recommendations exactly. Those recommendations were the unanimous views of the Executive Committee of the League, based upon the expressions of our A.R.R.L. Board of Directors at its last annual meeting, and were regarded as technically sound and desirable by the technical staff at Headquarters. We believe that a moment's serious consideration will indicate that they are by long odds in the best interests of amateur radio.

At one of Secretary Hoover's national radio conferences some years ago a committee on amateur matters succeeded in opening the lower 100 kilocycles of the 80-meter band to amateur phone. That regulation was never looked upon with favor by a majority of our Board, who regarded it as a mistake because of the very serious interference to telegraph operation which amateur phone on 85 meters immediately introduced into that band. Now it is most important that that not happen in the 80-meter band, which is by long odds our most important telegraphing band. The organized national communications service of the League, our message traffic, our emergency and distress communications, take place almost altogether in that band. It is the very heart of the League organization, the nucleus of those activities which have held this League together and which have made it the valuable national asset which brings to us the endorsement and support of our Government, without which we would very soon suffer. On the other hand, the main operating territory of amateur phones has always been in the region above 150 meters, although in the past they have been confined there to a band of but about 100 kilocycles width. The 150- to 200-meter band is used very little for telegraphy to-day. Those frequencies are ideal for telephony, chiefly because selective fading is so much less there than in the 80-meter band and also because of the greater ease with which stability of the oscillator may be attained. Nor is there any particular difference in the performance of the two wave-bands—both are essentially "national" in character, one is about as good as the other, and neither shows any particular "skip effect". What could be more logical, then, than that our Board should feel that all short-range or domestic amateur telephony should go together in one large band in a region where the accidental trend of amateur development has caused the virtual abandonment of amateur telegraphy? The important telegraphy of the 80-meter band would be freed of the really serious interference from amateur phone; amateur phone could be given the much greater (more than twice as great) expanse of territory which it needs and has been requesting, in wavelengths of substantially identical performance, and in a region where, although not guaranteed as exclusive for phone, the possibility of interference from amateur telegraphy—which is a bad handicap in phone operation—would be infinitely less.

So our Board thought. And our A.R.R.L. Board, as we have repeatedly said in *QST*, is the "big boss" in A.R.R.L. affairs. It is our governing body, it creates our policies, and at its annual meetings it tells our officers what to do during the coming year. Even if our Executive Committee and Headquarters Staff had been of a contrary mind when the matter of our recommendations arose, they could have no option, for the Board had spoken. But it was unanimously believed that such a change in amateur regulations was greatly to be desired and in the best interests of amateur radio—as much in the interests of the phone man as of the code man. *QST* sees no reason for altering that view now; it seems to us perfectly apparent that it is in the best interests of each group to have the arrangement as it now stands. Probably it is only natural that any amateur at first blush should feel hurt at the loss of any privilege and at the necessity for making any changes in his apparatus. It is of course intensely regretted that the amateurs operating phone on 85 meters are put under the temporary inconvenience of shifting wave. Any such readjustment is always distressing, because communication is interrupted until antenna and coils can be changed and a set retuned. We sincerely believe, though, that mature consideration will convince everyone that the new regulations are all to the good.

If there be phone amateurs who after this mature consideration are unable to think of the new regulations as wise and who persist in the view that they have been treated unjustly, Headquarters would suggest that they write to their individual Division Directors about it, as the Directors will have their annual meeting in February and it is the Board which governs.

In passing, let it be stated that the opening of certain higher frequencies to amateur phone was in no sense as a substitute for the 85-meter privilege, but as additional wavelengths for long distance and international operation. American amateur telephony has never had an international wavelength before. The opening of a portion of our 20-meter band to amateur telephony now gives our phone experimenters the same opportunity for long-distance work that the amateurs of so many other nations enjoy and will lead, we hope and believe, to some very interesting developments in this field.

K. B. W.

# A Low-Power Master-Oscillator Transmitter

By Beverly Dudley*

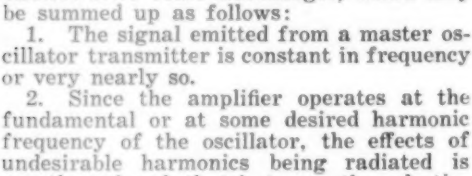
THE necessity for maintaining the amateur's transmitter on a constant and definitely known frequency is becoming increasingly more stringent as frequencies of 1,500 Kc. and more are being investigated and used by commercial and experimental interests. If a transmitter is built to operate at a constant frequency within one or more of the frequency channels assigned to amateur use, the operator will cause much less interference than if his transmitter emitted a wave, the frequency of which was subject to variation upon the least provocation. Not only will the interference be less, but because of the constancy of the emitted wave, signals will be readable at points where they could not be copied if an unsteady wave were emitted.

### ADVANTAGES OF M. O., P. A. CIRCUITS

Transmitters of the master-oscillator, power-amplifier type sometimes known as separately excited transmitters, can be made to hold their emitted frequency to within narrow limits during the time of transmission *provided the circuit is properly designed.* This is the most important characteristic of master oscillator transmitters although separately excited transmitters have other advantages, which may be summed up as follows:

1. The signal emitted from a master oscillator transmitter is constant in frequency or very nearly so.
2. Since the amplifier operates at the fundamental or at some desired harmonic frequency of the oscillator, the effects of undesirable harmonics being radiated is greatly reduced, that is to say the selectivity of the amplifier cuts down the undesired frequencies.
3. As the amplifier tube may be made to oscillate at all times when being keyed, the danger of overheating because of the failure of the oscillating circuit, is avoided.
4. Modulation of radiophone or i.c.w. transmission (if desired) may be carried out at relatively low powers, thus reducing the cost and complexity of the modulating apparatus.
5. Changes in the radiating system may vary the power output, but if the design is correct will not greatly affect the frequency of the signal.
6. The following adjustments are almost entirely independent of each other:

   A. Frequency of the oscillator circuit.
   B. Frequency of the amplifier circuit.
   C. Frequency of the antenna circuit.
   D. Antenna coupling.
   E. Adjustment of the oscillator circuit for the delivery of maximum power to the amplifier.



FRONT VIEW OF THE SET

**At the left are the filament rheostat and antenna ammeter, next the key binding posts. The central dial tunes the amplifier and the right hand one tunes the oscillator.**

### THE OSCILLATOR

It is generally conceded that a crystal controlled transmitter fills the requirements of amateur transmitters best of all. A crystal controlled transmitter, if properly designed, is the most constant type of oscillator available for amateur transmission. However, such a transmitter has the disadvantage of not being able to change the frequency of the emitted signal, so that if interference is encountered, it is impossible to change to a different frequency freer from interference. Of course several crystals having slightly different frequencies of oscillation might be employed, but even this is not as flexible as an oscillator which is not controlled by a crystal. Furthermore, the cost of even one quartz plate is frequently a big factor in low power amateur transmitters let alone the price of several different plates.

It is of course true that the principal reason for employing quartz crystals is to maintain the oscillator at a very constant frequency. With the proper design the frequency of master oscillator circuits not crystal controlled may very closely approach the constancy of frequency of the crystal controlled transmitter. There is nothing particularly difficult in constructing a good master oscillator transmitter that will maintain its frequency constant to within very narrow limits.

### THE OSCILLATOR CIRCUIT

The first thing to consider in building a master oscillator transmitter is the oscillator circuit. The design of the oscillator circuit is important since even a separately excited transmitter may emit signals which are not constant in frequency if the circuit

*Radio Editor, Chicago Evening Post, also owner Station 9BR.

design is not properly carried out. Constancy of frequency and stability on all commonly used amateur frequency bands, as well as ease of adjustment and operation are probably the major requirements for the oscillator circuit.

While any oscillator circuit that operates satisfactorily in the amateur frequency

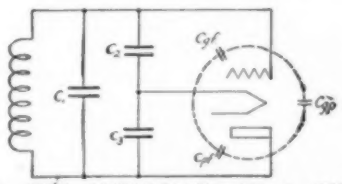



FIG. 1. THE ADVANTAGES OF A COLPITTS CIRCUIT EXPLAINED

**Each tube capacity is shunted by a condenser which must be large for best results. In the set here described C2 and C3 each have a fixed capacity of 400 μμfd and C1 has a maximum capacity of 250 μμfd. Thus the capacity across the coil may be as large as 650 μμfd. It is never made less than 420 μμfd. This should be compared with ordinary amateur practice.**

bands might be used to excite the amplifier tube, the Colpitts oscillator was chosen in building the low power master oscillator transmitter at 9BR, since it seemed to possess the desirable features in the best proportion. The Colpitts oscillator may be used in operating in any of the amateur frequency bands, and once adjusted is thoroughly stable, the circuit is very easily adjusted and tuned, changes from one frequency band to another may be made with interchangeable coils that do not require taps, and finally, the Colpitts circuit has rather large capacities in shunt with the tube inter-electrode capacities which greatly helps in maintaining constancy of frequency.

One of the most disagreeable annoyances in copying high frequency continuous wave signals is the change in frequency—resulting in a "drifting" beat note—of the signal, that occurs as the tube is gradually heated during operation. Ordinarily this frequency change, or creeping is only noticed when a tube is first heated and put into operation, but if the tube is overloaded, or the circuit poorly designed, rapid creeping or "chirping" may be noticed every time the key is closed. The decrease in frequency as the tube warms up is due to the slight thermal expansion of the tube elements which causes a change in the inter-electrode capacities of the oscillator tube.

Two methods of reducing this creeping may be employed at present, although if the power tubes of the shielded plate type make their appearance, much of our present trouble may be eliminated. The simplest and safest method is to heat the tube by lighting its filament a few minutes before it is to be used, and by *using the tube at its rated power output* and not at several hundred per cent. overload. While this system will not always work out to entire satisfaction, it will go a long way in helping to keep the frequency from changing as the circuit is keyed. Another method of reducing creeping is to employ a low ratio of L to C in the circuit, and to use a circuit such that the inter-electrode capacities of the tube are only a small portion of the total capacity of the circuit. If, then, changes do occur in the tube's capacity due to thermal expansion of the elements, the per cent. of change of the total circuit capacity will be small, so that the frequency of oscillation will remain very nearly constant, and not shift the beat note out of the audio range.

The Colpitts circuit is particularly suited to the latter method of preventing changes in the emitted frequency as may be seen in considering Fig. 1 which shows the essentials of the Colpitts oscillator circuit. The inter-electrode capacities of the tube are represented by $C_{gf}$, $C_{pf}$, and $C_{gp}$. The condensers $C_2$ and $C_3$ are used to secure the proper feedback. $C_1$ is an adjustable or variable condenser used to accurately control the frequency of the emitted wave. It will be noted that $C_1$ is in parallel with $C_{gp}$, that $C_2$ is in parallel with $C_{gf}$ and that $C_3$ is in parallel with $C_{pf}$.

Now the frequency of oscillation is dependent upon the values of L, $(C_1 + C_{gp})$, $C_2 + C_{gf})$, and $C_3 + C_{pf})$. It will therefore be seen that if a low L/C ratio is used in the circuit, and the capacities of $C_1$, $C_2$, and $C_3$ are several times as large as their cor-

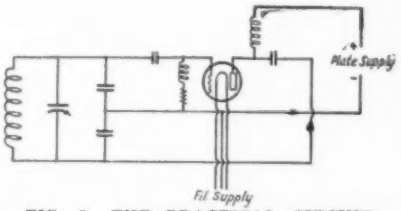



FIG. 2. THE PRACTICAL CIRCUIT

responding internal tube capacities, changes in the tube capacity will have a negligible effect on the frequency of oscillation. This is an important consideration, since, in the majority of high frequency transmitters, a slight change in the circuit capacity will change the frequency of the emitted signal by such an amount that the heterodyne at the receiving station may change several thousand cycles and may even go beyond the frequency of audibility.

An operative circuit making use of the advantage just mentioned is shown in Fig. 2. The frequency of oscillation is de-

termined by the values of L, $C_1$, $C_2$, and $C_3$ as before, and if the values of these capacities are *at least ten times the tube capacities*, the circuit will be found to be steady, and tuning throughout the entire frequency range of the transmitter is accomplished by varying $C_1$. To change the frequency of the emitted wave by large steps, L may be replaced by an inductance of larger or smaller value.

While the type of Colpitts oscillator of Fig. 2 might be coupled to the antenna for purposes of transmission, and would maintain its frequency more constant than some other circuits, the use of a power amplifier to couple the oscillator to the antenna will greatly improve the transmitter. The load of the antenna is thus removed from the oscillator to the amplifier, and changes in the antenna circuit, while varying the power output, will not affect the frequency of the signal, which is determined by the oscillator circuit.

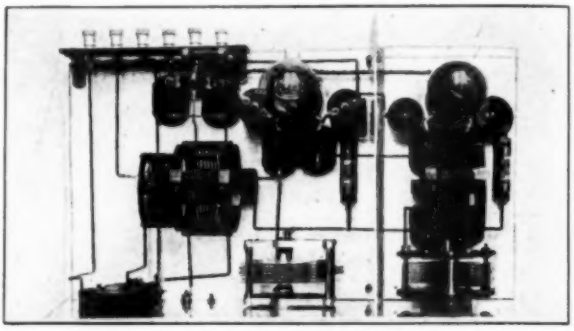


FIG. 4. THE SET TILTED FORWARD

**The small compartment at the right contains the oscillator with its fixt and variable tuning condensers, inductance, grid leak and two chokes and two fixed condensers, one pair each for plate and grid. The large compartment contains the amplifier and all parts can be seen so plainly that no explanation is needed.**

### MASTER OSCILLATOR TRANSMITTER

Fig. 3 shows the schematic wiring diagram of a master oscillator, power amplifier arrangement using a Colpitts circuit. The oscillator is the same as that shown in Fig. 2, except that it is capacitively coupled to the power amplifier. The amplifier is a standard shunt feed affair, inductively coupled to the antenna, and probably needs little or no detailed description.

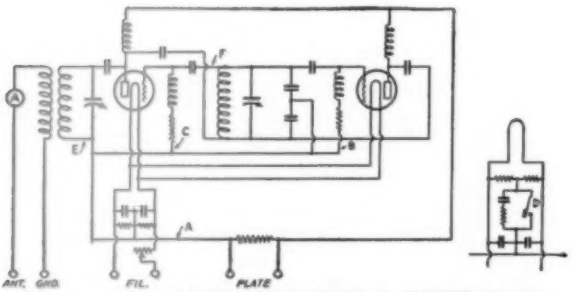



FIG. 3. THE OSCILLATOR WITH A NEUTRALIZED AMPLIFIER ADDED

**The resistor across the plate supply discharges the filter and prevents accidents. The small diagram shows a method of center-tap keying with minimum key thump.**

The circuit of Fig. 3 was used in experimental work in building up the final model of the transmitter, which was intended to be—excepting antenna and power supply—self contained so that it might be used at practically any sort of installation, requiring very little time to put the circuit into operation.

Various keying positions were tried, as shown by the letters. Key clicks were found to be objectionable when the key was in position A, B, or C. A slightly different form of center tap keying, shown at D was also tried, and while the results obtained were better than those obtained at A, B, or C, it still gave trouble. In order to keep the oscillator operating at nearly uniform temperature, to keep the capacity changes due to expansion to a minimum, it was desired to keep the oscillator running continuously, keying in the amplifier circuit somewhere. A key was tried at F, but the capacity of the key and its associated wiring was so great that the distributed capacity passed nearly all the r.f. energy and keying could not be accomplished in this manner. Finally the key was inserted at E, breaking the r.f. circuit of the plate circuit of the amplifier. Keying in this position permitted quick and steady keying without producing objectionable key clicks. In fact the clicks were so faint that they could barely be heard on a three circuit regenerative circuit using three audio stages, the receiver and the transmitter being only three feet apart. While the plate voltage, is, at all times, applied to the plate of the tube, and some plate current is thus always being drawn, no difficulty was experienced in overheating the amplifier tube. Other arrangements might have to be made, however, if tubes larger than the UX-210 tubes are used.

When the circuit of Fig. 3 was built and operated satisfactorily, the transmitter was rebuilt into its final form. The circuit used in the final model is shown in Fig. 4, while the photographs show the general construction. The transmitter was built with the idea that it should be as simple to operate as possible, and all unnecessary items, such as filament voltmeters, and plate current meters, etc. were eliminated. It was intended that the transmitter be so designed that it would operate with any kind of antenna system so that simplification was further carried out by leaving out loading coils or series condensers in the antenna circuit, these items being supplied, as found necessary, in the particular installation in which the transmitter is located.

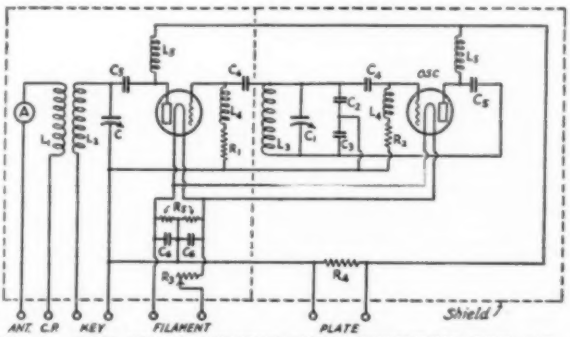



FIG. 5. THE FINAL CIRCUIT WITH SHIELDING BUT NO NEUTRALIZING AND WITH THE KEY IN THE TUNED PLATE CIRCUIT OF THE AMPLIFIER

A—Antenna ammeter
L1—Antenna inductance—Aero
L2—Amplifier plate coil—Aero
L3—Oscillator coil—Aero
L4—Grid R.F. chokes—Aero
L5—Plate R.F. chokes—Aero
C1—Oscillator tuning condenser—G. R. type 247, max 250 μμfd.
C2—Grid oscillation condenser—Sangamo, 400 μμfd.
C3—Plate oscillation condenser—Sangamo, 400 μμfd.
C4—Coupling condenser—Sangamo, 100 μμfd.
C5—Plate blocking condenser—Sangamo, 2000 μμfd.
C6—R.F. filament bypass condenser—Sangamo, 250 μμfd.
C7—Amplifier plate circuit tuning condenser—B. T. max. 500 μμfd.
R1—Grid leak—Tobe—7,500 ohms
R2—Grid leak—Tobe—10,000 ohms
R3—Filament rheostat—Howard 1½ ohm, 2½ ampere
R4—Discharge resistor—Elmenco—250,000 ohms
R5—Center tap resistor—Carter—100 ohms each side

While the circuit and photographs explain details quite well, a few words of description may not be amiss. As may be seen from the photographs the rheostat is placed below the antenna current meter, the binding posts are for the key, and the condenser, from left to right are the amplifier tuning condenser and the oscillator tuning condenser. It will be noticed that the transmitter is housed in an aluminum case, which besides offering a strong and light container was found to offer sufficient shielding to make neutralization of the amplifier not only unnecessary but undesirable. Fig. 4 shows the transmitter, tilted forward the case being removed. The arrangement of parts shown makes it possible to do a very nice job of wiring, in this case the oscillator was wired with thirteen inches of wire, the amplifier requiring approximately five or six feet more.

Aero interchangeable coils are used, and the circuit is so arranged that only one frequency band is covered (with each type of Aero coil) in the oscillator circuit. The values of $C_1$, $C_2$ and $C_3$ of Fig. 5 are so chosen that the amateur bands are covered between about 10 and 90 on the oscillator dial. This makes accurate tuning easy to accomplish.

The oscillator circuit contains a similar Aero coil and a 500-μμfd. condenser so that the amplifier circuit may be tuned to the same frequency as that of the oscillator, or to one of its harmonics.

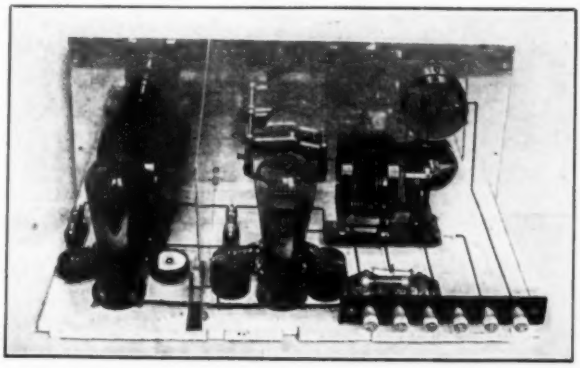


FIG. 6. A REAR VIEW OF THE SET

From left to right the binding posts are—positive and negative plate supply (shunted by the 250,000 ohm discharge resistor right above the strip), two filament posts (shunted by the center-tapped resistor and pair of condensers), ground (or C. P.) and antenna.

Fig. 6 shows the rear view of the transmitter, which helps to see the location of

parts better. The rack of binding posts makes all connections—except to those of the key—for the transmitter. Fig. 6, the posts are, from left to right, positive and negative plate posts, two filament posts, ground and antenna. The circuit is intended for a.c. on the filaments, but d.c. may be used. The grid leaks used are the 5-watt Tobe fixed resistor. A resistance of 10,000 ohms for the oscillator and 7,500 ohms for the amplifier proved the best experimental values. All fixed condensers are the mica moulded Sangamo condensers which were found to stand up very nicely with plate voltages up to 750. Sangamo condensers designed for transmitting circuits are now available, however. During the period of experimental work, it was found, through a number of "first hand" experiences, that the rather large filter at 9BR took quite a long time to discharge. Consequently a discharging resistor, $R_4$ of 250,000 ohms was used in the experimental model and worked so well that it was used in the final model. The discharge resistor may be seen above the plate binding posts in Fig. 4 and Fig. 6.

As has already been mentioned, and as can be seen from the schematic wiring diagram, no neutralizing system was required in building the aluminum housed transmitter. A neutralizing system was originally used, as shown in Fig. 3, but was later discarded because it was found to decrease the output, and furthermore, the circuit as shown in Fig. 5, was found to be perfectly stable even when both the amplifier and the oscillator were operating on the same frequency.

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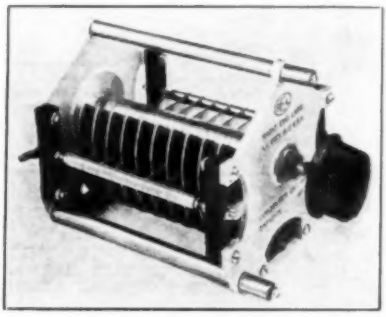
## Variable Transmitting Condensers

THE accompanying illustration shows a transmitting condenser that has been recently placed upon the market.

The frame consists of two heavy aluminum castings which are the end pieces and carry the bearings. These are held together by means of three heavy brass rods making the frame both strong and rigid.

The plates are made of brass and are approximately 1/16" thick. Both the rotor and stator assemblies employ accurately turned spacers to separate the plates. The shaft carrying the rotor plates is of very generous proportions and is made of steel. Cone shaped bearings are provided and the shaft diameter at the bearing is ⅜ inch. Because of the cone bearings, it is possible to take up any slack that may appear due to wear. This should not occur very readily though, because the bearings have been subjected to a rotation test to insure that they have been properly fitted before the condenser left the factory. At the end of the unit which is screwed to the panel, the shaft has been turned down to ¼ inch to take care of any standard knob or dial. The other end of the shaft extends through the



bearing to allow coupling to another condenser for tandem operation or for any other similar arrangement. This end of the shaft has been turned down to ⅜ inch.

The stator plate assembly is insulated from the rigid endplates which carry the rotor, by blocks of hard rubber. These blocks are highly polished which helps materially to reduce loss due to creepage between the stator plates and the rotor assembly. The actual contact between the stator plates and the insulating blocks is so small as to be almost negligible. The temperature coefficient is low enough to be of no importance.

They are made in three voltage ratings. The 3,000 volt size has spacing of ¼ inch between adjacent plates of the same potential. The spacing for the 5,000-volt size is ½ inch and for the 10,000-volt units, it is 1 inch. The maximum capacities range between 25 μμfds. and 650 μμfds. depending upon the voltage rating and number of plates.

Three metal stand-off bushings are supplied for back-of-panel mountings. Insulating bushings may be obtained for mounting to metal panels. In all but the largest sizes, these bushings will carry the weight of the unit. In the largest, though, it will be advisable to employ additional support at the end farthest from the panel.

These units were designed to be used in oscillating circuits carrying from 100 to 2,000 watts and also will be found to be suitable for laboratory work and in other places where condensers of low power factor, small dielectric losses and high potential breakdown are essential.

It is a product of the Radio Engineering Labs of Long Island City, N. Y.

—*H. P. W.*

# MacMillan and Party in Labrador

By Clark C. Rodimon*

THE *Bowdoin* has been known to amateurs as WNP since Don Mix went north on board as the first radio operator in 1923. In June of 1927 the Rawson-MacMillan Field Museum Expedition sailed from Wiscasset, Maine, for a trip on the Labrador to last some eighteen months. Cliff Himoe, at the time 1IK ex-9AOG, was chosen as radio operator on the present trip.

At this time the *Bowdoin* is frozen in Anatalok Bay, Labrador. The party of twelve is spending the winter in this bay which is also known as Bowdoin Harbor. The various bits of news that are to be related are some of those that have been gleaned by the writer on his daily 20-meter WNP schedule.

This year, WNP first came into realization when a d.c. signal was heard signing WNP on thirty-six meters.

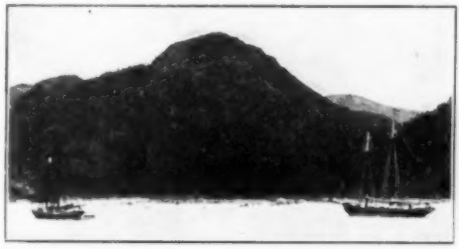
Shortly after leaving the U.S., WNP went down to the 20-meter band and found QSO there much better than on the 40-meter band. Immediately, contact was had daily with Europe and the United States. Since that time, every continent save the Far East has been worked.

The *Bowdoin* was trailed to Nain, Laborador, by a supply ship, the *Radio* otherwise known as WOBD. Nain is a settlement a few miles from the winter quarters of the Expedition. On board the *Radio* was the "makings" of a building that was to house the members of the Expedition during the bleak winter months when the *Bowdoin* would cease swinging at her anchors and be held fast in the bay by ice.

In September, the *Bowdoin* made a dash to Frobisher Bay, Baffinland. Commander MacMillan was not with the party, as he had gone south to St. Johns, Newfoundland, on a business trip. The captain of the *Radio* piloted the *Bowdoin* while his charge lay at anchor at Nain. The scientific staff of the Expedition carried on research work in Frobisher Bay during the three weeks stay of the ship there. WNP at this location put through some real hefty signals, in fact the audibility of these signals reached a peak that has not been equalled before or since. Rarely was there a signal in the 20-meter amateur band that would come in with as much volume as WNP during her stay in Baffinland. Evidently this extra thousand miles distance added more than enchantment!

When the *Bowdoin* dropped anchor once again at Nain, the *Radio* and crew made ready for departure and left within a few days. MacMillan came back from his trip to St. Johns a little later amid a great welcome. That evening WNP signed off with the hasty explanation that Mac had just returned.

From the time that the *Radio* turned south, WNP was the only signal from Labrador. After the first few days of forty-meter work WNP had dropped to the twenty-meter band and remained there with occasional hops to the higher band as the forty-meter signals were not breaking through consistently. However, communication had been conducted regularly, between WOBD and WNP on thirty-six meters at noon.



**THE BOWDOIN AND RADIO ANCHORED IN ANATALOK BAY**

**Ashore in the center of this photograph is where the scientific station and house is located. The Bowdoin is the smaller ship on the left.**

The Dempsey-Tunney bout in Chicago was of as much interest to members of the Expedition as to folks back in the States. After the result of the fight there was one person in Labrador, at least, who took the sporting chance of picking the winner of this melée and consequently two people in the United States are satisfied this Labradorian did!

Moving into new houses in Labrador is no different in some respects from moving right here at home. A rush message came through one evening with a request for telephone delivery to the addressee living in Massachusetts. This person having been a member of the Expedition until the *Radio* came home was supposedly responsible for the misplacing of the dishes for equipping the kitchen and dining room of the new home. The next morning a reply message went north on regular schedule to the effect that a man on the *Bowdoin* and still with the Expedition had stored the dishes. He was reminded of their hiding place. That

*1SZ-1BIZ, A.R.R.L. Headquarters.

evening eleven men smoked at the chagrin of the twelfth!

On Thanksgiving Day, the MacMillan party moved into the "house". This is also the scientific station, depending on who is telling about this structure. A week previous to this opening, a house-warming was held to celebrate the event. One thinks of things in Labrador that might well be forgotten in the U. S.

About the middle of November there were anxious messages going to and from the Expedition. The last boat taking supplies and mail (no other boat expected before July) was two weeks late, and it was feared

THE VOICE BEHIND WNP

Cliff had just gone through a tonsorial treatment before going 18 months without another! This photograph was taken by a friend on board the Radio.

that the boat could not break through. Commander MacMillan remained in Nain for two weeks awaiting the arrival of the boat. Then he returned to Anatalok Bay with the depressing news that no mail had come. Supplies were missing, too. A message went up to the Expedition telling them that the *Kyle*, the long-awaited mail boat, had left her supplies at Nain and was already back in St. Johns. Himoe and the writer both agreed that it was a real practical joke on MacMillan. He had been waiting two weeks in Nain for supplies that were there all the time! Our bit of humor was discarded the next day when a telegram from St. Johns said that the trip of the *Kyle* that had been referred to was one that had been previously made. In consequence of this mishap a careful check was made on the fuel that drives the generator that puts the mighty WNP on the air. It was ascertained that there was enough to last until late summer providing the minimum amount of operation was done with no superfluous sending.

This meant a change in the tactics of WNP. Rag-chewing was at an end; operation assumed a strictly business basis from this time on. I secretly believe that Himoe slipped up the weights on his "bug" quite a bit; in this way to save operation, time

A BIT OF SCENERY GLIDING PAST BATTLE HARBOR, LABRADOR, IN MID-SUMMER

and the priceless fuel. His steady fist is readable and a delight to copy at any reasonable speed, so nothing was said and I proceeded to write a little faster!

The supplies were not missed nearly as much as the mail. Outgoing mail that was to have gone on the *Kyle* stayed in Nain and did not go out. This will have to wait until a dog sledge goes north in January. And some of the letters in the mail sack were written in September! Decidedly, amateur radio is speedier than mails. If there hadn't been amateur radio, the Commander might have spent his winter in Nain, each day thinking there would be some news of the *Kyle*. Receiving letters in Labrador is the greatest event known, premier only to receiving radio messages.

Traffic is handled on schedules with WNP by numerous stations on both the twenty- and forty-meter bands. The twenty- meter band has proved to be the more reliable, and WNP can be heard on this band when he is sending, for thirteen hours each day!

After local conditions have kept WNP off the air for a few days the call comes forth on twenty meters as the old guard on twenty recognizes WNP's signal the instant it is run across. Then comes the explanation for the absence of WNP for those days.

Recently, Himoe and another member of the party had an experience that any of us would remember for quite some time. As the *Bowdoin* is anchored a quarter of a mile out in the bay from the camp site, the operator had to row out to the boat before ice formed. The gales and driving snow storms had kept the bay open much later than usual, so that the rowing

changed to a process of breaking thin ice all the way out to the *Bowdoin*. This certain day the fellows were half way out to the boat when the little craft capsized, throwing both boys into the icy bay. The ice would by no means hold their weight. With considerable difficulty they managed to struggle to a tiny island that luckily was near at hand. There they remained nearly all day before their plight was discovered by MacMillan. Needless to say, WNP was not heard that day.

By this time the *Bowdoin* is frozen solidly in the ice, and Himoe insists that he is operating a land station. These frosty mornings Cliff goes out to the *Bowdoin* in regular Roman fashion, chariot and all; he makes use of a dog team. Not many fellows go out to their radio shacks via dog team!

Calisthenics are not forgotten, we are reminded, when Himoe tells of climbing up the anchor chain to board WNP. The morning he related that novelty he did not forget to boast of the fact that it was colder in his sanctum than in mine. He said the thermometer indicated fifteen below zero but he would give it more than that! The reason for coming up the anchor chain may have been for the purpose of getting some extra exercise before sitting down to a cold pair of headphones and a fifteen-below-zero schedule. From now on it is the mitten sending, but we must be informed of this fact as the character of the sending has not been impaired in the least. We also marvel at Himoe's still being able to write down messages in series of ten, being handicapped by a bulky pair of mittens.

One morning when below-zero weather prevailed in Labrador, the writer was asked to stand by for an hour while a fire was brewed as there was a snag of traffic at each end. At the end of the hour WNP told us that he had built the fire and that he was feeling great as the mercury had come up over the zero mark and was slowly creeping upward, as were his spirits. After traffic had been handled we were asked to stand by for another half hour while a report was compiled for *QST*. At the end of this intermission, Himoe said that he had not finished with the report as he had been playing with his old friend the fire. (We hope he did not burn his fingers.) Evidently that slow creep of the mercury had halted, wavered and then slipped down into the depths again.

WNP makes use of a 204-A with about 300 watts input from a generator. The note is nearly always pure d.c. save when a chopper of about 200-cycle frequency is used for traffic when WNP is breaking through with a real loud signal.

## A New Chief Signal Officer

WHEN we speak of the United States Army valuing and appreciating the radio amateur we are talking primarily of the Army Signal Corps. This is the branch of the Army which handles its communications and in which radio and radio operators find their chief place. It is the branch with which we have had that definite bond of affiliation which has resulted in the Army-Amateur Net. This is the branch which calls upon us when the "Army" needs coöperation from amateurs and is generally the branch which speaks for us when the "Army" has something to say about amateurs. For these reasons if for no other we are interested in the Chief Signal Officer of the Army.

During January Major Charles McK. Saltzman the Chief Signal Officer reached the age of retirement. The relations between amateur and Army have reached their present high point during the incumbency of General Saltzman. Our present affiliations with the Signal Corps were contracted during his office. That this relation was most fruitful for us was gorgeously proved at the recent International Radiotelegraph Conference where General Saltzman served as chairman of the technical committee of the American delegation and was largely responsible for the very splendid support which the American delegation gave the cause of amateur radio, as reported in our January issue. We have reason enough to be very grateful to him and our heartiest good wishes go with him as he leaves the Service.

The new Chief Signal Officer is Major General George S. Gibbs, who has been the Signal Officer of the Second Corps Area with headquarters in New York City. As Corps Area Signal Officer Colonel Gibbs (as he then was) of course had occasion to know much about radio amateurs and by his frequent attendance at Director Dunn's meetings of the Hudson Division he has been thoroughly "exposed" to us and believes in us. It is good to have as the new Chief Signal Officer one who knows and understands us as well as General Gibbs does.

—*K. B. W.*

CRACKLE FINISH

# Dog-Day Doldrums

By Ross A. Hull*

*Our household pup spent a wretched day yesterday. Not that that is anything really unusual, for though Sput is a very human little wretch, he has a miserably morbid disposition and sulks quickly into a state of sluggish boredom if someone, human or canine, does not provide diversion for him. Sput's mental condition yesterday, however, seems to have been slightly varied, for Spit who lives two doors north, and Spat from three houses south, provided ample diversion by trespassing across the lawn. Sput, though never sufficiently ambitious to go afield seeking amusement accepted this localized challenge and a glamorous and gory scrap ensued. Sput, our dog, claimed the victory but in the process of recon-*

*ditioning himself sank into profound melancholia. Very clearly, he had decided for the moment that there was nothing more to live for now that he had conquered Spit and Spat—who seem to have comprised the only two worlds in Sput's narrow mind. Of course a rat will walk out of its hole soon and provide another one but Sput didn't think so.*

ALL of which, possibly, is beside the point and at least foolish. In any case I am in possession of neither dog nor household and the story is lacking in foundation. The point is, however, that some dogs and most humans drift into a temporary state of quiescence, boredom and stagnation just as soon as they lack an objective, or from the moment when they inwardly believe that they have mastered the problems confronting them. Particularly is this so in the case of the radio amateur. The per capita enthusiasm of the radio amateurs, and the corresponding advance, I believe, has always been greatest at periods when the difficulties and problems appeared most profound. When a month of juggling with spark coils and electrolytic detectors failed to give contact with AZ three blocks away; when 50 miles could be covered only if one had the enthusiasm to build and rebuild, tune and retune for weeks at a time; when the hearing and working of a station a thousand miles away set the zenith of accomplishment and the objective of all Hams; when the Atlantic could be spanned if one's station was tuned to the last fraction of a "hot wire ampere"; when the Pacific could be conquered if only the plate wouldn't melt at 600 mills or if the tube could be persuaded, after a few weeks jiggling, to oscillate on 100 meters "them was the days" when amateur enthusiasm rose to enormous peaks.

"But now," bemoans misguided OM Ham, "there is nothing more to do. If the amateur had been blotted out of existence at the Conference there might have been some thrill in operating a bootleg station and getting away with it, but now there is no justification even for that. We have shown commercial radio how long range radio is to be done, we have proven our value to the Army, Navy and the Press, and the whole world's radio interests admit that we are a useful band of enthusiasts helping to develop the science. The young fellows can get their kick out of building a station and working the world in the first week but—ho hum—that's all there is, there isn't any more." Which all boils down to the fact that we amateurs are humans—that our tendency is continually toward quiescence and boredom and that as humans we must resist this drift toward monotony by constant search and grasping for new worlds to conquer.

If we could only realize it we are fortunately situated in this regard for the amateur game is still as rich in new worlds to conquer as any other field of human endeavor we know about. OM Ham is very human in thinking that the game is threadbare—he thought the same between the peaks ten years ago—but he is now, as then, "all wet". And to prove it let's talk about this 20-meter phone.

* Experimenters Section and Technical Information Service A.R.R.L.

If ever circumstances conspired to provide amateurs with an objective crammed with interest and as wide as the world in scope it was, surely, when the upper end of the 20-meter band was opened for telephony. To my way of thinking this privilege, new in this country, will do more to restore the enthusiasm of mature hams than any other one factor and will most certainly result in loud whoops of joy on the part of the many foreign amateurs who have had as their chief interest that rare but unequalled sport—DX phone. As one of this tribe I recall the time, three years ago, in Australia, when nothing would have gladdened my heart so much as the opening of the 40- or 20-meter bands to the U. S. amateurs for phone. At that time, as now, slices of readable phone could be sent to or

received from the English amateurs to the accompaniment of the grandest "kick" that amateur radio can provide. But then, as now, the English signals rarely if ever equalled the strength of those from the U. S. and while we would hear Englishmen at R5 and get phone from them we would, within the same twenty four hours, hear scores of U. S. signals at R6 and R7 any one of which would have provided the most excellent phone if only such working had been lawful. "Just why don't the U. S. hams wake up to DX phone and press their Government for permission to use it?" I used to think. "Surely they can't think that an amateur to be an amateur must work exclusively with a key—surely they don't think that short wave phone is any less a part of short wave development than key punching!"

To my surprise, on arriving in this country, I found just this state of mind to exist. The amateur with an interest in phone was found to be in extreme minority, and almost all of these fellows had their minds sidetracked along broadcasting lines. The nearer their outfits resembled broadcasting stations in spirit and appearance the better they were pleased. The message handling and "CQ DX" amateurs seemed unanimous on their opinion that phone was foreign to amateur radio, while the phone men seemed to feel that by interesting themselves in phone they had deserted the ranks of the true amateur. Both of these viewpoints being, to me, puzzling if not ridiculous.

Phone, to my way of thinking, is just as much a part of short wave development as any other of its phases and should for even this reason be just as integral a part of true amateur radio as telegraph. I must admit, of course, that I wonder at times how amateurs can spend the evening yelling, "How is my modulation now?" at another fellow fifty or a hundred miles away, but I do insist that international and general DX phone operated for just those contacts and friendly "rag-chews" that the 40- and 20-meter code work has provided is a field of true amateur work of magnificent interest and limitless scope.

Of course, the difficulties at the beginning will appear great, for even 40- and 20-meter DX code work is very much a will-o'-the-wisp. There is not the slightest doubt, though, that satisfactory two-way phone working under good conditions, will be possible between any two points on the earth just as soon as amateurs become conversant with the new standards involved and build transmitters and receivers suited for the work. Such contacts over distances of more than a few thousand miles may be few and far between but, from experience, I can say that each of them will provide "that grand and glorious feeling of accomplishment" in large salubrious gobs.

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## North Carolina-Roanoke Division Convention

**March 2nd-3rd, 1928, Charlotte, N. C.**

GANG, here it is again, the 2nd annual Roanoke Division Convention (North Carolina Section). Keep in mind the above dates. The Charlotte Amateur Radio Assn. is again sponsoring the affair and those who attended last year know what a good job they did. The committee in charge is planning more this year and cordially extends an invitation to all amateurs in neighboring states. Director Gravely will be with us and he promises to do all in his power to bring Secretary K. B. Warner, from A.R.R.L. Headquarters, for our guest of honor.

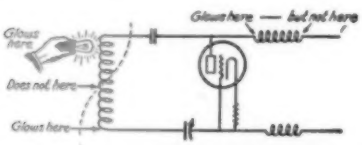
All meetings will take place at the Chamber of Commerce, and T. R. Banks, Sec'y of the Club, 2233 Avondale Ave., Charlotte, N. C. will be glad to hear from those who contemplate being present.

# Cheap "Neon" Lamps and How to Use Them

By F. S. Huddy*

IN the course of visiting a large number of stations in this country and Europe, the author was surprised at the general lack of knowledge of that useful little article, the neon lamp. It has a multitude of uses in the amateur station, and I believe that many more would be used if they were more generally known and were cheaper. You are going to say right away, "This is all old stuff,"—and so it is, in a way. But I *know* that an amazingly large part of the gang never used a neon tube or anything like it, particularly sensitive ones such as I refer to. I have found some men testing chokes with lead pencils —they make a lovely yellow flame!—and when there isn't enough juice to make a quarter inch arc, the choke is labelled "O.K." It happens in my set that anything that isn't just so burns up immediately and thus indicates its unworthiness, but the chap with the 5 watt peewee doesn't have that luck, and he doesn't always have enough power to light a spark tester, of which more later. Ergo, I think that a few pointers on how and where to get some cheap, sensitive indicators are not amiss.

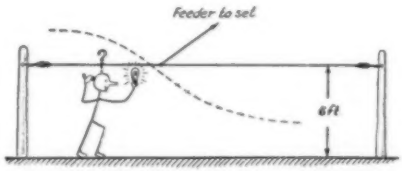
The first lamps that were used were the "Spark-C pencils" that are used in testing automobile spark plugs. They consist of a glass tube containing neon gas under low pressure, and one metallic electrode. They are not at all sensitive and require a high voltage to get them going. This means that they go out whenever the voltage drops




FINDING VOLTAGE NODES ON INDUCTANCES AND CHOKES
FIG. 1

to a few hundred, and indicate to the unwary that a certain choke is functioning perfectly when really it is leaking juice all over the lot and may have its lower end at a potential of several hundred volts above that at which the tube says it is. Hence, the need of a more sensitive indicator was felt as soon as the defects of the old tubes became apparent.

While the author was in Europe, he found some neon lamps there in very common use. They are made like the 75-watt gas-filled Mazdas in shape and size. They only draw 2 or 3 watts and will not move an ordinary watt-hour meter, and that explains, perhaps, their absence in this country. The remarkable thing was that they light up on *110* volts instead of requiring a thousand or so. Two of them were brought home, and upon trial soon proved that they were worth their weight in gold in detecting small radio frequency voltages in unsuspected places. They were tried in a wavemeter, and it was found that the coupling could be reduced far below the




TO FIND VOLTAGE DISTRIBUTIONS ON DIFFERENT ANTENNA PUT UP LOW TEST ANTENNAE
FIG 2

loosest possible coupling for the old style Spark-C tubes. In short, there was no doubt that they were worthwhile. But they are not sold here, and it is hard to get them, hence the author cast about for something better.

The first thing that was found was the small neon lamps put out by the Edison Lamp Works in New Jersey. These are made in two sizes, 1/20 watt and 1 watt. They sell for 75c and $1.00 respectively. They are neat and convenient. The small size has a candelabra base and the larger has a standard Edison base. They have, however, two disadvantages. First they cost too much. Second, they have a very high resistance in the base of each lamp which does not improve their work-in in radio frequency circuits. The resistance can be taken out by skilled surgeons, but it's a nuisance, so the search went on.

Not long ago, the author went into that amateur's paradise known as the 5- and 10-cent store. On the counter were some small carbon 110-volt bulbs. They were rated at 2 c.p. and were marked "Japan" on the base. "Hexx," thot ye scribe, "the Japanese don't know how to get all the air out of a bulb, and what is more I don't believe anyone can do it for ten cents and then give you the bulb and the other works into the bargain." So two of the lamps were bought and rushed home. The small 20-meter set was started up and the bulbs brought near the inductance. When fully 18 inches away, they both lit up with a

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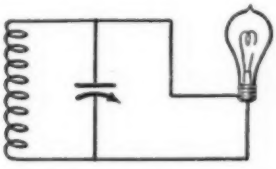
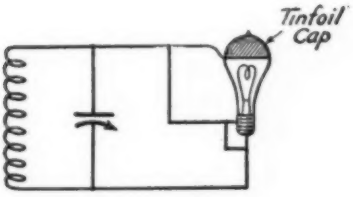
bright blue glow. "Eureka," I said, as did old Archimedes, but instead of running down the street sans attire as he did, I switched over on the big 20-meter set and tried again. Just how much power that big set uses had better remain a secret, but both bulbs lit up four feet from the grid end of the inductance. Did someone say "You are using W. E. tubes?" Yes, wise one, I am, two of them in parallel! And there is a 5 k.w. line going into the set, too, but that is beside the point.

A test was then made to see how much better or worse the new found lamps were than the regular neon bulbs. To the delight and amazement of the writer, they proved to be almost as sensitive as the best of the foreign tubes. But one cloud remained on the horizon. Suppose these bulbs were the exception rather than the



FIRST SCHEME AS USE IN W.M.



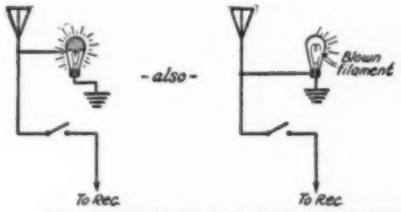

SECOND IDEA

FIG. 3

rule. There was only one way to decide, and it was done by the simple process of buying a dozen more bulbs. They all worked as well, and some worked better. So now you have it,—all the sensitive indicators you want for 10c each. I have found these same useful bulbs in four 10c stores, both Kresge and Woolworth, so I think the gang can get 'em.

Some amateurs know how to use these gas tubes and some don't. The first use that comes to mind is that of finding the voltage node on your transmitting inductance. If you don't use a filament tap, it may be anywhere along the inductance. To find out, hold the test bulb by its metal base and slide the glass part along the inductance as in Fig. 1. It will glow brightly at the ends of the coil, but will go out at some point along its length. This point is the voltage node quite exactly since the lamp remains lit even after the voltage has dropped below its ignition point. It might be said in passing that if the node occurs in the center of the inductance, your circuit is properly balanced.—(Assuming a "single coil" circuit.—*Tech. Ed.*)

The same manner of application may be used to find the voltage distribution on your




DETECTING ABSORPTION OF POWER OR WORKING OF SET

FIG. 4

antenna. How do you get up to do it? Dunt esk! That's why we drew Fig. 2 with a low antenna.

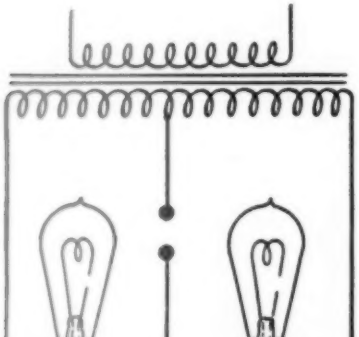
A third use is that as an indicator in a wavemeter. There are two methods of doing this. The first is quite satisfactory and also spectacular in its execution. Blow the filament (what ham needs to be told how!) and then connect as shown in the first diagram of Fig. 3. If you want to get an indicator with a minimum of capacity, do not bother to blow the filament, but connect the thing as shown in the 2nd diagram. The electrode on top is a piece of tinfoil. This is not so sensitive as the other connection, but has the advantage of having very low capacity.

In *all* the uses of the lamps it will be noted that the glow tends to lag. In other words, the glow persists after the exciting voltage has dropped below that necessary to initiate the glow. This is somewhat of a drawback, but can be obviated by paying attention to the point at which the glow starts. Also, resonance is located half way between the two points up and down on the scale at which the glow *ceases*.

Another use can be made of these by those who use syncs, high power, and separate antennae. In my station the tubes in the receiver are wrecked promptly if left turned on even though the receiver is ten feet from the transmitter and not connected during transmission to antenna or ground. It is also true that the sync refuses to start "sunny side up" about 99.8% of the time. The transmitter cannot be seen from the receiving tables easily and it used to be hard to tell when the sync was perking right. Now all is well. One of the ever useful bulbs was connected between the re-

ceiving antenna and the ground. When the transmitter perks, the bulb lights up nicely, connections being per diagram Fig. 4. It is interesting to watch the bulb during a thundershower. It lights up at each flash of lightning.

One other use was found that may interest the gang who cannot afford kenotrons for these 201A sets. While monkeying around the 2200 volt plate transformer, it was noted that one of the bulbs glowed



AS RECTIFIERS
FIG. 5

dimly when the base was touched to one side of the 2200 and the glass held in the hand. (Dangerous experiment!!!) This suggested that the tubes could be used for rectifiers. It was tried, and worked nicely. The first step is to blow the filament. Blow it good and hard by connecting the bulb across about 1500 volts. This will (in nine cases out of ten) leave one small piece of filament and one large piece, each connected to one lead in wire. Here we have the elements of a gaseous rectifier, whose rectification is in proportion (theoretically) to the areas of the electrodes. It works. Connect the bulbs as shown in Fig. 5. The two small electrodes should be connected together and the two large ones connected to the ends of the power transformer. Continuous (though pulsating) current may then be drawn from the center tap on the secondary and the common connection of the lamps. It may be filtered as usual. At least 700 volts will be needed to start things going (that's 1400 volts in all). The voltage drop is very great, but the tubes make a very nice little rectifier for such uses as the grid biases on C. C. sets.

Doubtless other uses may be found for these lamps. They cannot be correctly called "neon" lamps for they have but very little neon in them. The blue glow is very much like that in a Raytheon rectifier, but I leave it to you to find out what the gas is. Meanwhile thank your stars that even the Japanese can't for 10c pull all there is in a bulb out of it.

## We Grow

AMATEUR RADIO showed a growth of 13.6 per cent. in the past Government fiscal year, according to the recent annual reports of the Chief of Radio Division and of the Secretary of Commerce. Good news, and reassurance we hope to those who had been fearing that amateur radio was slipping. The following quotation is from Mr. Terrell's annual report:

"During the past fiscal year the number of amateur transmitting stations increased from 14,902 to 16,926. Much credit is due to the amateurs for their contribution to the development of short-wave transmission. Nearly all of the amateur stations are now operating on wave lengths of 80 meters and below.

"It seems appropriate to mention briefly here some of the more important public services rendered by amateur stations during the past year. Immediately following the Florida hurricane many amateur stations in Georgia, Florida, Alabama, Mississippi and Louisiana provided the only means of communication with the stricken sections. They handled important and urgent messages between the State and municipal authorities, messages for the Red Cross consisting of requests for food, medical supplies, and doctors. Much of the same service was performed during the Mississippi flood. For the past three years the American Radio Relay League, through the American Railway Association, has placed its stations and facilities at the disposal of railroads for use as a means of emergency communication should their regular wire system be interrupted. Actual use of this emergency service has been made several times during the past year."

## Strays

If you are interested in a plug-in choke for the receiver, the following suggestion by A. A. Kopf of Ancon, C. Z. may be of help.

"File the ends off an old Amperite glass tube after the metal caps have been removed and insert a piece of quarter inch glass rod that has been wound full of fine wire inside of it. The ends of the wire come out to make contact with the metal end pieces that came on the Amperite and the assembling job may be made with wax and rosin or with woodsmetal. The choke can then be plugged into the mounting and is easily changed if it becomes necessary."

# The Shielding Efficiency of Metals

By Ralph B. Mason*

DURING the past few years much attention has been given to the theory and practice of shielding radio equipment. Experimentation has been quickly followed by commercial application and an examination of almost any factory built receiver of today will reveal some form of shielding. Some rather astonishing results have been obtained with completely shielded commercial sets and many a "handy man" has attempted to shield his favorite set with varying degrees of success. For example, an article by an enthusiastic fan tells how he used an old coffee can for a shield and obtained wonderful results! After measuring the resistance at radio frequencies of a coil shielded by a coffee can, one can appreciate the disadvantage of placing radio frequency c ils in an iron container.

A previous article in this magazine[1] has discussed the various changes in the characteristics of a coil when it is shielded by metal. While the general principles of shielding are simple, the practical application is not always so easy and the promiscuous application of metal to a set is not to be encouraged. Morecroft and Turner[2] have carried out a series of experiments upon the efficiency at audio and radio frequencies of shields of different metals and of varying thickness. However, most of their measurements were made at audio frequencies since they found that the efficiency of the better conducting metals was substantially 100 per cent at radio frequencies. Moreover, they did not give any data for aluminum, which is finding extensive use as a shielding material.

Some have contended that at radio frequencies, aluminum would have a high resistance due to the thin film of non-conducting oxide upon its surface. Our measurements show that aluminum does not behave in any extraordinary manner at radio frequencies and that its value as a shield can be predicted from its conductivity.

The work of Morecroft and Turner at 1000 cycles was repeated using shields of aluminum, copper and brass. Three duolateral wound coils were used, two of 200 turns each, and one of 300 turns. The 300-turn coil was used as a standard inductance on a General Radio inductance bridge. A current of one kilocycle frequency was furnished by a General Radio audio oscillator. The two coils of 200 turns each were mounted face to face 1.7 cm. apart and connected in series with the bridge. By means of a commutator the direction of the flow of current in one of the coils

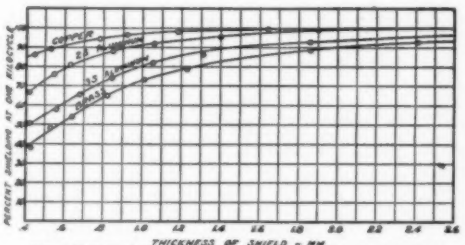



FIG 1 - SHIELDING EFFICIENCY OF VARIOUS METALS AT AUDIO FREQUENCY

could be reversed. The effective inductance was measured first when the current was flowing in the same direction through both of the coils and then again when the direction was reversed in one of the coils. Then various sheets of metal (18" x 18") were placed between the coils and the measurements repeated.

The percentage shielding is given by the expression,—

$$S = \frac{M-M'}{M} \times 100$$

where S=per cent. shielding.
M=coefficient of mutual inductance without shield.
M'=coefficient of mutual inductance with shield.

The coefficient of mutual inductance, M, is given by the expression,—

$$M = \frac{L_1-L_n}{4},$$

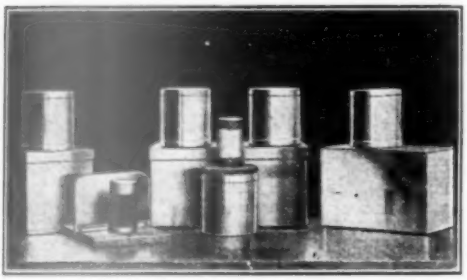
where $L_1$ is the inductance when the E.M.F's are in the same direction and $L_n$ is the inductance when the E.M.F's. are in opposite directions. The results of this experiment are shown graphically in Fig. 1. The aluminum is a better conductor than the brass and not quite as good a conductor as the copper (on the usual volume basis), and one would expect its shielding efficiency curve to fall just under the curve for copper. On the other hand if the shielding efficiencies of the 2 S aluminum and copper sheet had been plotted as a function of the weight instead of the thickness, the relative positions of the two curves would have been reversed. It must be remembered that

*Research Bureau, Aluminum Company of America, New Kensington, Pa.

1. D. R. Clemons, *QST*, March, 1926, pages 9-20.
2. Proc. Inst. Radio Eng., Vol. 13, p. 477-505, 1925.

these curves are for a frequency of 1 kilocycle (audio frequency).

Morecroft and Turner have shown that the shielding efficiency increases with higher



VARIOUS TYPES OF METALLIC SHIELDS USED IN EXPERIMENTAL WORK

frequencies until at radio frequency the efficiencies of copper and brass shields of reasonable thickness are practically 100 per cent.

Several experiments were carried out at a frequency of 500 kilocycles after making the necessary modifications in the original method but the thinnest sheets of copper, aluminum and brass all showed 100 per cent. shielding. This is in accord with the results of Morecroft and Turner. The method employed by Clemons in *QST* March, 1926, page 16, seemed to offer greater possibilities and was therefore used for the experiments upon shielding at radio frequencies. In the accompanying diagram (Fig. 2) O is the oscillator coil and A the small pick-up coil which are totally shielded from the rest of the apparatus by a large grounded aluminum box. A sensitive galvanometer and thermocouple were used to determine when circuit No. 1 was tuned to resonance by the condenser. The shield S was rigidly clamped in a wooden frame. The coil C of circuit No. 2 was tuned to resonance by a precision condenser, this point being determined by means of a very sensitive Western Electric vacuum thermocouple and a sensitive Leeds and Northrop galvanometer. The shields consisted of copper, brass, 2 S and 3 S aluminum[3], and were 18" by 18" square. They varied in thickness from .042 cm. to .260 cm. (B. S. gauge, 26 to 10, approx.)

It was soon discovered that an ungrounded shield allowed an appreciable current to be picked up by coil C. However, if the shield were grounded, the coil did not pick up enough current to give a deflection on the sensitive galvanometer and therefore the relative merits of the different shields could not be determined. Neither was it possible to differentiate between the various shields when they were not grounded as there was no appreciable variation in the amount of current flowing in the shielded circuit. For instance with 154 milliamperes flowing in circuit No. 1, each ungrounded shield of 26 gauge copper, 2 S or 3 S aluminum allowed 7.35 milliamperes to flow in circuit No. 2. However, it was noticed that circuit No. 1 seemed to have a little greater resistance when 3 S aluminum or brass shields were substituted for the copper or 2 S aluminum shields, and this observation led to the resistance measurements to be described later.

As was mentioned before, no current could be picked up when the shield was grounded. In combination with a sensitive galvanometer, a crystal detector may be used to measure currents of a few microamperes. Several experiments upon grounded shielding were carried out with this very sensitive indicating device taking the place of the regular thermocouple. The hookup was taken from the Bureau of Standards circular No. 74, page 165, and is shown in Fig. 3. A carborundum crystal detector acted in a very satisfactory manner being both sensitive and stable in its action. In an instrument of this type the galvanometer deflections are proportional to the square of the current. No attempt was made to standardize the instrument, as only relative measurements were desired.

At 600 meters no current could be detected passing through the heavier grounded shields with this extremely sensitive indicating device. With 123 milliamperes flowing in circuit No. 1 the following deflections (Table 1) were obtained for various thicknesses of shield.

**Efficiency of Shielding Vs Thickness of Shield**
**Wavelength = 600 meters**

| Thickness cm. | Approx. gauge | Shields 18" x 18" | Galvanometer Deflection cm |
|---|---|---|---|
| .042 | 26 | 3S | 61.7 |
| .056 | 23 | 3S | 10.4 |
| .068 | 22 | 3S | 0.2 |
| .085 | 20 | 3S | 0.0 |
| .042 | 26 | 2S | 3.9 |
| .055 | 23 | 2S | None |
| .048 | 24 | Copper | None |

TABLE 1

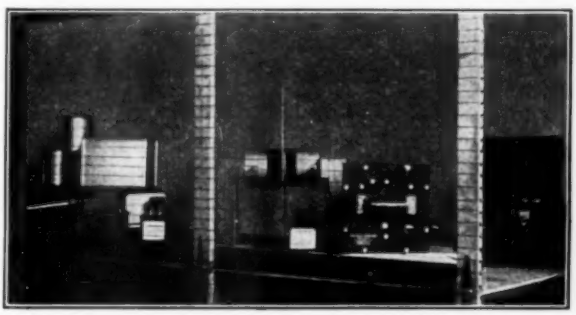
The thinnest sheet of copper did not allow any current to flow at 600 meters and the corresponding 2 S aluminum shield allowed very little current to pass, while the shield of 3 S aluminum, being a poorer conductor, allowed an appreciable current to flow. Table 1 shows that a sheet of 2 S aluminum .055 cm. in thickness did not allow any current to pass at the frequency used but a

3. 2 S is the trade designation for commercially pure aluminum sheet; 3 S is an aluminum-manganese alloy sheet having substantially lower conductivity than 2 S.

sheet of this thickness is not very rigid and for satisfactory working qualities it is suggested that at least 20 gauge (.081 cm.) sheet be used.

Hollow cylinders 4" in diameter and 4⅜" high were constructed from commercial 22 gauge brass, copper, 2S and 3S aluminum sheet. A tightly fitting cover was spun for each end, so that the metal of the cover extended ⅜" over the outer edge of the cylinder. The seam was brazed in the case of the copper and brass cans, but welded in the case of the aluminum. A coffee can (tinned iron) was found which had very nearly the same dimensions as the other cans and was used for comparison with them.

A small coil was wound on a 2" cardboard tube and mounted on a circular wooden disk of the same diameter as the metal cylinder. The coil with its mounting was placed in the metal can and connections made to a crystal detector indicating device through small holes in the side of the can.



**GENERAL HOOK-UP FOR TESTING THE EFFICIENCY OF LARGE FLAT SHIELDS OF DIFFERENT METALS**
**One of the shields may be seen between the two horizontal coils. The wire upon the hinged frame-work acts as an electrostatic shield between the apparatus and the operator.**

An attempt was made to pick up current from circuit No. 1, (Fig. 2) with this shielded coil a short distance from coil B. Large deflections of the galvanometer were obtained if the cans were ungrounded or the covers were not fitting tightly. (In one experiment a cubical copper can was used as a shield and a large deflection was noted when the cover did not make good electrical contact. After fitting the cover tightly, no deflection was noted until a small wedge was placed under the flange of the cover next to the radiating coil.) However, if the shields were grounded and the covers carefully fitted, not enough current was picked up to give a deflection on the galvanometer scale. Aluminum, copper, brass and iron seemed to be equally effective as shields, but more will be said in regard to the effect upon the resistance of the coil, especially in the case of the iron.

Two binocular coils were mounted equidistant from a small 4" x 6" flat sheet shield. The current from circuit No. 1 was passed through the coil on one side of the grounded shield. The other coil could not be completely tuned before the galvanometer deflection was too large to read, thus showing that a small wing shield does not offer complete protection, even though it is grounded and binocular coils are used. A shield of this type can very often be used to stabilize an oscillatory circuit, since the presence of the shield tends to increase the resistance of the circuit and stop the oscillation. The shield also changes the apparent inductance of the coil and can be used to tune one coil so that it will match the characteristics of another.

### RESISTANCE OF COILS

A metal shield may very effectively protect a coil from external electrical fields, yet it may so change the inductance, capacity and resistance of the coil that it will no longer serve the purpose for which it is used. On the other hand, shielding is sometimes purposely introduced in the circuit to change the constants of the coils in some desired manner.

The resistances of the various coils were measured at three wave lengths with the different forms of shielding in place. The resistance variation method described in Bureau of Standards Circular 74, page 180, was used to determine the coil resistances. Circuit No. 2, Fig. 2, was removed and the precision condenser used to tune circuit No. 1. Three straight wire resistance links were inserted, one after the other, between the grounded side of the thermocouple and the low potential side of the condenser. In this way, three values for the resistance were obtained and the average taken. The large shields of sheet metal (18" x 18") were clamped against a rigid back board, as it was found that concordant results would not be obtained unless the coil could be accurately placed at a given distance from the shield. The relative positions of the coil and shield were so adjusted that the axis of the coil was perpendicular to the center of the plane of the shield, while one end of the coil was close to the shield.

The field of a coil has a greater flux density at the end than along the side and a piece of metal perpendicular to the field of force around the end of the coil causes a more marked change in the coil characteristics than when parallel to the field of

force. Since the purpose of these particular tests has been to show any differences between copper, aluminum and brass in their effect upon the characteristics of a coil, the windings of the coils in the cylindrical cans were 1" distant from the sides and ends, and consequently the end of the

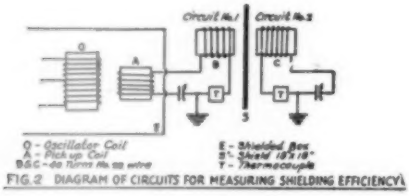


FIG. 2 DIAGRAM OF CIRCUITS FOR MEASURING SHIELDING EFFICIENCY

coils are closer to metal than they may be in ordinary practice. A recent article by Zahl in Radio News, Vol. 9, page 52, 1927, states that the shielding should preferably not come closer than one inch to the sides of a coil, and not closer than 2 or 3 inches to the end of the coil, where the field is more intense. The cylindrical cans are the same ones which were used in the experiments described above.

The following table (No. 2) shows the resistance of the various coils with different kinds of shielding, measured at three wave lengths, namely, 600, 300 and 200 meters.

**Resistance of Coils in the Presence of Metallic Shielding**

| Shielding Cylindrical Cans | 600 meters Resistance in ohms of circuit No. 1 with coil B4 | 300 meters Resistance in ohms of circuit No. 1 with coil B | 200 meters Resistance in ohms of circuit No. 1 with coil B |
|---|---|---|---|
| Copper | 5.38 | 4.15 | 10.86 |
| 2S Aluminum | 5.50 | 4.26 | 10.47 |
| 3S Aluminum | 5.57 | 4.34 | 11.22 |
| Brass | 5.66 | 4.64 | 11.88 |
| Iron | 10.07 | 7.50 | 17.04 |

| Shielding Wing Type Shields 26 Gauge | 600 meters Resistance in ohms of circuit No. 1 with coil B3 | 300 meters Resistance in ohms of circuit No. 1 with coil B4 |
|---|---|---|
| Copper | 6.77 | 4.98 |
| 2S Aluminum | 6.93 | 5.04 |
| 3S Aluminum | 7.13 | 5.08 |

TABLE 2

Coil B, 50 tuns No. 20 D.C.C. wire on 2" form

Coil $B_1$, 80 turns No. 22 D.S.C. wire on 2 form

Coil $B_2$, 40 turns No. 22 D.S.C. wire on 4" form

Coil $B_3$, 80 turns No. 22 D.S.C. wire on 2" form

The effective inductance of a coil is decreased when a shield is present, and in all cases a larger capacity was required to balance the circuit than when the unshielded coil was used. In most cases the 3 S aluminum and brass increased the resistance slightly more than copper, while 2 S aluminum was about on a par with the copper. The iron can increased the resistance of the coil to a marked extent, and for this reason iron should not be used.

The apparent resistance of a coil increases very rapidly with increased frequency, especially as the natural resonance period of the coil is approached. The resistance of a coil should be determined when the E.M.F. is introduced into the circuit by coupling with the coil itself. On account of the shielding, an external pick-up coil was used in the above experiments. Under these conditions the distributed capacity of the coil is in parallel with the coil, but in series with the rest of the circuit. The resistance values here given are valid only

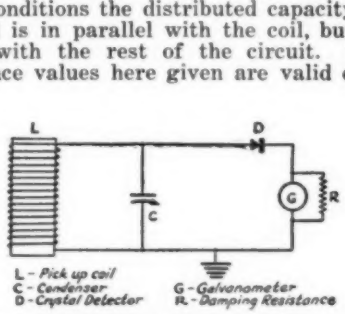


FIG. 3 CRYSTAL DETECTOR CIRCUIT USED IN MEASURING SMALL CURRENTS

when the coil is placed in the same position with respect to the other instruments and applied E.M.F.

## COMPARISON OF COILS WOUND WITH ALUMINUM AND COPPER WIRE

Thirty-two turns of bare copper wire (20 gauge) were wound on a 4" threaded bakelite tube and the apparent resistance measured when the E.M.F. was induced directly into the coil. After measuring the resistance of this coil at 200, 250, and 300 meters, an aluminum wire was wound on the same identical form and the measurements repeated.

If the high frequency resistance of the straight copper wire is calculated and then subtracted from the high frequency resistance obtained for the coil, a value is obtained which may be considered to be due to winding the wire into the form of a coil. The value thus obtained was added to the calculated high frequency resistance of the aluminum wire, and this sum of the two resistances equalled the experimentally determined resistance of the coil. The aluminum acted in a normal manner and its behavior could have been predicted from

its conductivity measured at low frequencies. The L/R ratio (where L=inductance and R=resistance) at 300 meters was 26.9 for the aluminum and 29.7 for the copper coil.

SUMMARY

1. Frequency, conductivity and thickness of sheet are important factors in determining the efficiency of metallic shielding.

2. At broadcast frequencies relatively thin sheets (up to 24 B. and S. gauge) of aluminum and copper show high shielding value. Commercially No. 20 B. and S. gauge and heavier sheet is used because it has the necessary working qualities and shielding efficiency.

3. Complete box or can type shields are recommended for coils. Partition or wing type shields are usually impractical on account of the large size necessary.

4. Box shields should have joints that make good electrical contact such as is obtained from a tight slip joint. There should be no more holes or openings than necessary to make connections.

## Resistors

AN INTERESTING type of resistance unit employing somewhat unusual mechanical construction has been placed upon the market under the trade name of, "Truvolt". A standard Nichrome resistance wire is wound around an asbestos covered enameled copper wire of about No. 20 guage. This method of coiling up the resistance wire allows surprisingly large resistances to be obtained in a small space. It also results in a flexible "wire" that may be used to connect together two terminals between which a resistor is to be inserted. This not only simplifies wiring but does away with the necessity for a separate mounting for the unit.

The resistors may be obtained in various ranges both as to resistance and the amount of energy they will dissipate. They may also be obtained as both fixed and variable units.

For the man who is using a filament lighting transformer not properly center-tapped, there are available units consisting of two matched resistors which have been riveted together. The standard two-hundred ohm size will safely pass 85 milliamperes. When connected across the filament of a 210 there will pass thru it approximately 40 mils due to the filament voltage. This leaves a margin of about 45 mils for both the plate and grid currents. As these currents should divide between both halves of the resistor, it makes the allowable combined plate and grid current somewhere in the neighborhood of 90 mils which should be plenty for the job.

For a couple of 210s or a 203-A, it will be necessary to use a standard variable unit which in the 200 ohm size is capable of passing over 350 mils. These resistors may also be used to drop the plate voltage in crystal and similar sets and may be had in resistances up to 100,000 ohms, capable of dissipating 75 watts. They may be used in all sorts of voltage dividing circuits as well as for grid leaks, etc.

The manufacturer is Electrad, Inc. of New York City.

—*H. P. W.*

## Changes in Radio Division

MR. Bernard H. Linden, who has been acting Supervisor of Radio for the Sixth District since the appointment of the late Lt. Col. Dillon as Federal Radio Commissioner, has now been confirmed by the Department of Commerce as Supervisor. This is good news to his many friends. Mr. E. A. Beane resigned in late November as the Supervisor at Chicago, to enter private business, and has been succeeded by Mr. Harold D. Hayes, formerly of the Sixth and Seventh Districts and for the past two years in the Chief's office at Washington. Both Mr. Linden and Mr. Hayes are old-timers at their business, and both have a sympathetic understanding of amateur radio. We welcome and congratulate them both.

The recent appropriation of funds by Congress now makes some very desirable expansions possible in the Radio Division. Branch offices under Radio Inspectors are being planned for Buffalo, Dallas, Denver, Los Angeles and Minneapolis, and for either St. Louis, Omaha or Kansas City. Additional radio test cars are being built and equipped, and new apparatus of the finest type, capable of accurately measuring frequency and field strength on all waves down to some point below 20 meters, will soon be available in every District. The service has needed this increase in personnel, equipment and funds for a long time; happily it is now at hand.

—*K. B. W.*

IN THIS CASE ITS DIFFERENT

# Extracts from the Washington Convention

THE new International Radiotelegraph Convention and Regulations signed at Washington on November 25, 1927, constitute a document which in its printed form fills 118 pages. It does not seem that it will be placed on public sale, in this country at least, until it is ratified by our Senate, or possibly until a "definitive edition" is released by the Berne Bureau. It seems appropriate, therefore, for *QST* to reproduce those portions of the document which are of immediate interest to the amateur fraternity.

The convention has a preamble which recites that the plenipotentiaries of the governments enumerated have met and adopted this text. Definitions follow, and then the numbered articles, from which the following are selected, from a translation supplied by the United States government.

### Article 1

1. The contracting Governments undertake to apply the provisions of the present Convention to all radio communication stations established or operated by the contracting Governments, and open to the international service of public correspondence. They undertake likewise to apply these provisions to the special services covered by the Regulations annexed to the present Convention.

2. They agree, moreover, to take or to propose to their respective legislatures the necessary measures to impose the observance of the provisions of the present Convention and the Regulations annexed thereto upon individuals and private enterprises authorized to establish and operate radio communication stations in the international service, whether or not open to public correspondence.

### Article 8

The stations covered by Article 1 must, so far as practicable, be established and operated under the best conditions known to the practice of the service and must be maintained abreast of scientific and technical progress.

All stations, whatever their purpose, must, so far as practicable, be established and operated so as not to interfere with the radio communications or services of other contracting Governments and of individuals or of private enterprises authorized by these contracting Governments to carry on public radio communication service.

### Article 22

The present Convention shall go into effect on January 1, 1929; and shall remain in force for an indeterminate period and until one year from the day on which a denunciation thereof shall have been made.

The denunciation shall affect only the Government in whose name it has been made. The Convention shall remain in force for the other contracting Governments.

Following Article 23 the signatures of the plenipotentiaries are affixed, and then come the General Regulations from which the following are quoted:

### Article 1

In the present Regulations, supplementing the definitions given in Article Zero of the Convention:

.....The term "private experimental station" means:

1. A private station intended for experiments with a view to the development of radio technique or radio art;

2. A station used by an "amateur," i.e., by a duly authorized person interested in radio technique solely with a personal aim and without pecuniary interest...

### Article 2

1. No radio transmitting station shall be established or operated by an individual or by a private enterprise without special license issued by the Government of the country to which the station in question is subject.

2. The holder of a license must undertake to preserve the secrecy of correspondence, both telegraph and telephone. Moreover, the effect of the license must be that the interception of radio correspondence other than that which the station is authorized to receive is forbidden, and that, in the case where such correspondence is involuntarily received, it must not be reproduced in writing, communicated to others, or used for any purpose.....

### Article 3

1. The choice of radio apparatus and devices to be used by a station shall be unrestricted, provided the waves emitted comply with the provisions of these Regulations.

2. (1) The Administrations must take the necessary measures to assure themselves that the frequency meters (wave meters) employed in the adjustment of the transmitting apparatus are as accurately calibrated as possible by comparison with their national standard instruments.....

### Article 4

2. Waves emitted by a station must be maintained upon the authorized frequency, as exactly as the state of the art permits, and their radiation must also be as free as practicable from all emissions not essential to the type of communication carried on.

3. The interested Administrations shall fix the tolerance allowed between the main frequency of emissions and the recorded frequency; they shall endeavor to take advantage of technical improvements progressively to reduce this tolerance.

4bis. The width of a frequency band occupied by the emission of a station must be reasonably consistent with good current engineering practice for the type of communication involved.

4. In cases where frequency bands are assigned to a specified service, stations in that service must use frequencies sufficiently remote from the limits of these bands, so as not to produce serious interference with the work of stations belonging to services to which are allocated immediately neighboring frequency bands.

### Article 5

The Administrations of the contracting countries may assign any frequency and any type of wave to any radio station within their jurisdiction upon the sole condition that no interference with any service of another country will result therefrom.

2. These Administrations, however, agree to assign to stations, which by their nature are believed capable of causing serious international interference, frequencies and types of waves in conformity with the rules for allocation and use of waves as set forth below.

3. The Administrations agree also to consider the table of allocation of frequency bands (see paragraph 7) as a guide giving, for the different services, the limits which must be observed by all new stations and to which they shall adapt all existing stations with the least practicable delay, without diminishing the quality of the service which these existing stations carry on and taking into account the present state of their installations.

7. The table opposite shows the allocation of frequencies (approximate wave lengths) among the various services:

There follows here a lengthy table in which all the wave lengths from 30,000 meters to zero are allocated to various services. We reproduce the table only for the wavelengths below 200 meters:

| Frequencies in kilocycles per second | Approximate wave length in meters | Services |
|---|---|---|
| 1500–1715 | 200–175 | Mobile services. |
| 1715–2000 | 175–150 | Mobile services.<br>Fixed services.<br>Amateurs. |
| 2000–2250 | 150–133 | Mobile and fixed services. |
| 2250–2750 | 133–109 | Mobile services. |
| 2750–2850 | 109–105 | Fixed services. |
| 2850–3500 | 105–85 | Mobile and fixed services. |
| 3500–4000 | 85–75 | Mobile services.<br>Fixed services.<br>Amateurs. |
| 4000–5500 | 75–54 | Mobile and fixed services. |
| 5500–5700 | 54–52,7 | Mobile services. |
| 5700–6000 | 52,7–50 | Fixed services. |
| 6000–6150 | 50–48,8 | Broadcasting. |
| 6150–6675 | 48,8–45 | Mobile services. |
| 6675–7000 | 45–42,8 | Fixed services. |
| 7000–7300 | 42,8–41 | Amateurs. |
| 7300–8200 | 41–36,6 | Fixed services. |
| 8200–8550 | 36,6–35,1 | Mobile services. |
| 8550–8900 | 35,1–33,7 | Mobile and fixed services. |
| 8900–9500 | 33,7–31,6 | Fixed services. |
| 9500–9600 | 31,6–31,2 | Broadcasting. |
| 9600–11000 | 31,2–27,3 | Fixed services. |
| 11000–11400 | 27,3–26,3 | Mobile services. |
| 11400–11700 | 26,3–25,6 | Fixed services. |
| 11700–11900 | 25,6–25,2 | Broadcasting. |
| 11900–12300 | 25,2–24,4 | Fixed services. |
| 12300–12825 | 24,4–23,4 | Mobile services. |
| 12825–13350 | 23,4–22,4 | Mobile and fixed services. |
| 13350–14000 | 22,4–21,4 | Fixed services. |
| 14000–14400 | 21,4–20,8 | Amateurs. |
| 14400–15100 | 20,8–19,85 | Fixed services. |
| 15100–15350 | 19,85–19,55 | Broadcasting. |
| 15350–16400 | 19,55–18,3 | Fixed services. |
| 16400–17100 | 18,3–17,5 | Mobile services. |
| 17100–17750 | 17,5–16,9 | Mobile and fixed services. |
| 17750–17800 | 16,9–16,85 | Broadcasting. |
| 17800–21450 | 16,85–14 | Fixed services. |
| 21450–21550 | 14–13,9 | Broadcasting. |
| 21550–22300 | 13,9–13,45 | Mobile services. |
| 22300–23000 | 13,45–13,1 | Mobile and fixed services. |
| 23000–28000 | 13,1–10,7 | Not reserved. |
| 28000–30000 | 10,7–10 | Amateurs and experimental. |
| 30000–56000 | 10–5,35 | Not reserved. |
| 56000–60000 | 5,35–5 | Amateurs and experimental. |
| Above 60000 | Below 5 | Not reserved. |

Note—It is recognized that short waves (frequencies from 6,000 to 23,000 kc/s approximately—wave lengths from 50 to 13m approximately) are very efficient for long distance communications. It is recommended that as a general rule this band of waves be reserved for this purpose, in services between fixed points.

18. Each Administration may assign to amateur stations frequencies chosen from the bands allotted to amateurs in the allocation table (paragraph 7 above).

The maximum power which these stations may use shall be fixed by the Administration concerned, taking into account the technical qualifications of the operators and the conditions under which the stations must work.

All the general rules fixed in the Convention and in these Regulations apply to amateur stations. In particular, the frequency of the waves emitted must be as constant and as free from harmonics as the state of the art permits.

In the course of their transmission, these stations must transmit their call signals at frequent intervals.

Article 5 ter

5. (1) The exchange of communications between private experimental stations of different countries shall be forbidden if the Administration of one of the interested countries has given notice of its opposition to this exchange.

(2) When this exchange is permitted the communications must, unless the interested countries have entered into other agreements among themselves, be carried on in plain language and be limited to messages bearing upon the experiments and to remarks of a private nature for which, by reason of their unimportance, recourse to the public telegraph service might not be warranted. [The French text reads "....*ne saurait entrer en consideration.*"—Editor.]

(3) In a private experimental station authorized to carry on transmission any person operating the apparatus, either on his own account or for another, must have proved his ability to transmit text in International Morse Code signals and to read by ear texts thus transmitted. He can be replaced only by authorized persons possessing the same qualifications.

(4) Administrations shall take such measures as they deem necessary to verify the qualifications, from a technical point of view, of all persons handling the apparatus.

Article 14

1. Fixed, land, and mobile stations covered by paragraph 1 of article 1 of the Convention as well as private experimental stations must have a call signal from the international series assigned to each country in the allocation table below. In this table, the first letter or the first letters of the call signals shall identify the nationality of the stations.

There follows a table of allocation of call signals, which space at present does not permit us to reproduce. In ample time before the inauguration of the new system in 1929 we shall present the table. The Regulations also sugest the use of the intermediate "de". Thus with calls that indicate nationality, and the standard intermediate "de", amateur intermediates may be abandoned in 1929:

2. The call signals shall consist of:

(a) three letters in the case of fixed and land stations;

(b) four letters in the case of ship stations;

(c) five letters in the case of aircraft stations;

(d) the letter or letters indicating the nationality and a single figure followed by a group of not more than three letters, for private experimental stations.

There are several appendices annexed to the regulations. One of these is a new and much more lengthy Q Code of three-letter abbreviations, bearing small resemblance to the present code. Another appendix lists a considerable number of miscellaneous abbreviations, many of which should be useful to us amateurs. *QST* will present them in good season—they are not effective until 1929.

—*K. B. W.*

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As we go to press we are advised by the Superintendent of Documents, Government Printing Office, Washington, that the English translation of the new International Radiotelegraph Convention, with attached regulations, is now carried for public sale by that office, price 25c per copy (stamps not accepted). League members are urged to procure a copy and become familiar with its contents.

# Measuring the Inductance of an Iron-Cored Choke Coil at Different Currents

By J. Katzman*

**After having said for years that iron-core inductances are uncertain we here offer the explanation and a method of measuring the uncertain "L".—Tech. Ed.**

IN the July, 1927 issue of the *QST*, I described a bridge to measure capacity, power-factor, resistance and inductance. The method there described to measure inductances will give accurate results for air-cored coils. For iron-cored coils, however, the magnitude of the current flowing through the coil very materially affects its inductance, and hence that particular method will give the inductance of an iron-cored coil for small currents only. When such choke coils are used in a filter combination as shown in Fig. 1, the current passing through the coils, is, for most commercial coils, sufficiently large to have quite an effect on their inductances. The same bridge and capacity standards may also be used to measure the inductances of iron-cored coils, with various direct currents flowing through them, as will herewith be shown.

When in 1923 experimentation on the first B-eliminators was started in the Dubilier Laboratories, the engineers observed the reduction in inductance with current. They also observed the well-known phenomenon that when the direct

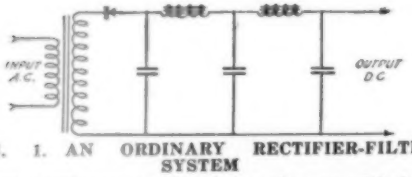


FIG. 1. AN ORDINARY RECTIFIER-FILTER SYSTEM

**The inductance of the chokes changes with load as shown in Fig. 2.**

current is large, an air-gap may actually increase the inductance of the coil. Fig. 2, shows the variation of inductance of an iron-cored choke coil with d.c. The coil was made up of 9000 turns with a length of magnetic path of about ten inches and an effective cross-sectional area of about ¼ square inch. For curve 1, the air-gap was 9 mils (.009") while for curve 2, the air-gap of the same coil was increased to 20 mils (.020").

It may be of interest here to depart from the main purpose of this article, which is to show how to obtain the inductance, and to examine the reason why such a variation

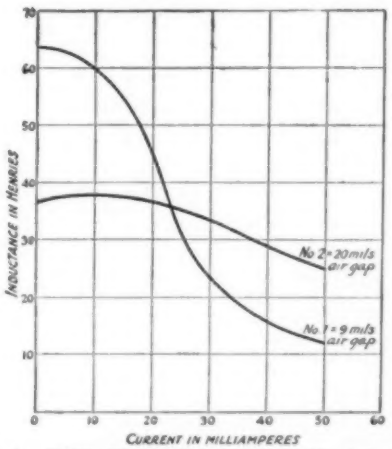


FIG. 2. HOW THE INDUCTANCE OF AN AIR-CORE CHOKE CHANGES WITH THE LOAD

**Both curves are for the same coil and core as described in the text. How should these chokes be rated?**

of inductance with current takes place.

The inductance of a coil depends upon the change of flux with change in current. The exact formula for inductance is:—

$$L = N \frac{d\varphi}{di} 10^{-8}$$

Where L = inductance in henries
N = the number of turns
$d\varphi$ = the change of flux
di = the change in current that produced thechange in flux.

For a constant number of turns and a constant current range, the inductance varies directly as the total flux, and for a constant area the inductance varies directly as the flux density.

In Fig. 3, two curves are given, No. 1, is a curve showing the approximate flux density plotted against ampere-turns for the 9000-turn coil with a 9 mil gap, while No. 2, is the curve of flux density of the same coil with a 20 mil gap for correspond-

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ing magnetizing forces. For the purpose of demonstration, assume that superimposed upon the direct current is an alternating current ripple in each of these coils of 2 2/9 milliamperes, giving 20 ampere-turns for the 9000 turns. It is, therefore, seen from Fig. 3 that for 10 milliamperes of d.c. (ampere-turns = 90) the additional 2 2/9 milliamperes will produce about 5500 additional lines of force per square inch

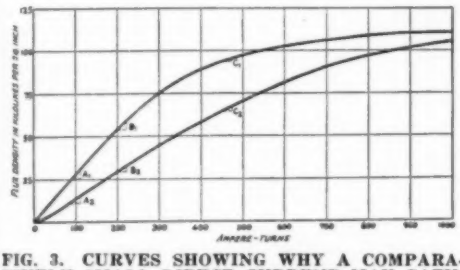

FIG. 3. CURVES SHOWING WHY A COMPARATIVELY SMALL DIRECT CURRENT MAY SATURATE THE CORE AND THEREBY REDUCE THE INDUCTANCE OF A CHOKE COIL IN THE MANNER OF CURVE NO. 1, FIGURE 1

for the coil with the 9 mil gap as shown at $A_1$, and about 3500 additional lines of force per square inch in the coil with the 20 mil gap as shown at $A_2$. The ratio of inductance at 10 milliamperes for the coil with each of the gaps is therefore:

$$\frac{L1}{L2} = \frac{5500}{3500} = 1.57$$

where L1 the inductance of the coil with the 9 mil gap and L2 the inductance of the coil with the 20 mil gap.

From Fig. 2 at 10 milliamperes

$$\frac{L1}{L2} = \frac{60}{38} = 1.58$$

thus showing the close relationship between the inductance and flux.

Again at 22½ milliamperes, Fig. 2, shows the two inductances to be equal and at $B_1$ and $B_2$ in Fig. 3, the flux changes are equal (about 3200 lines per square inch.)

For 50 milliamperes of direct current

$\frac{L1}{L2} = \frac{10.8}{24.8} = .43$ from Fig. 2, and

$\frac{L1}{L2} = \frac{1000}{2200} = .44$ from Fig. 3 at $C_1$ and $C_2$.

The reduction in inductance for the coil with the large air-gap at very small direct currents as shown in Fig. 2, is due to the bend in the magnetization curve at the origin which becomes more pronounced for this coil as seen in Fig. 3.

From the close agreement between the actual inductance ratios and the corresponding flux ratios, the relationship between flux and inductance becomes obvious. It can also be seen that the phenomenon of inductance variation with current, which at first looks peculiar, can really be deduced from the well known magnetization or B-H curves for air and iron.

The method of measuring the inductance that will now be described was employed in obtaining the curves of Fig. 2. Fig. 4 shows the bridge with the tuned 1000-cycle amplifier which was fully explained in the *QST* of July, and which was used in the above tests.

$R_1$ and $R_2$ are the fixed resistance arms of the bridge. "$C_3$" is a variable calibrated condenser while "C" is a fixed condenser, which for iron-cored choke coils in B-eliminator work may be between .00025 to .0005 μfds. "$C_3$" and the variable resistance $R_3$ are then adjusted until the 1000-cycle note heard in the ear phones becomes a minimum when "C" alone is in the other arm.

Two identical choke coils, of which the inductance is to be measured, L1, L2, are then connected in series with a milliammeter, a variable resistance and a battery. The resistance is adjusted until the current flowing in the coils is equal to that

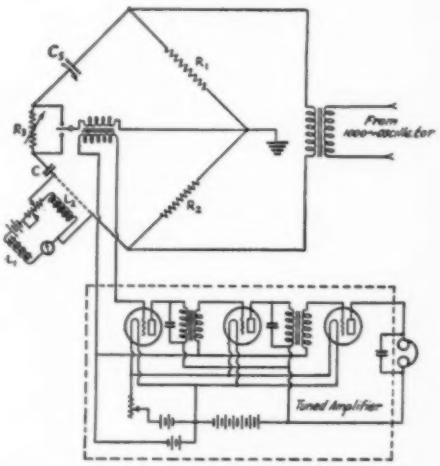


FIG. 4. A SPECIAL FORM OF WIEN'S SERIES RESISTANCE BRIDGE USED TO MAKE THE MEASUREMENTS DESCRIBED HERE

required, and the whole combination is connected in series with the condenser "C" as shown in Fig. 4. Condenser "$C_3$" is then increased and $R_3$ again adjusted until the 1000 cycle note heard in the ear phones becomes a minimum again.

If $C_2$ equals the capacity in microfarads of the variable when the inductances are connected,
$C_1$ equals the capacity of the variable when C alone is on the bridge, and
$L_X$ equals the inductance of the combination,

then

$$L_X = \frac{C2 - C1}{39.5\, C_2\, C_1} \text{ henries}$$

or practically $= \dfrac{C_2 - C_1}{20\, C_2\, C_1}$ henries

for each coil.

It is of interest to note that by means of this method a short circuited turn or turns is easily disclosed by the abnormally large increase in the resistance $R_3$ that such a short circuited turn makes necessary in order to balance the bridge, and by a very large decrease in inductance from that obtained for similar good coils.

It was thus shown that the apparently odd behavior of iron-cored choke coils is a natural predictable occurence and that two more uses for the "Wien's" series resistance bridge are its application to the measuring of inductances at desired currents and the detection of short-circuited turns.

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## West Gulf Division Convention

**February 10-11, 1928, Norman, Okla.**

HOORAY! Three times hooray. Say, fellows, a real-to-goodness A.R.R.L. Divisional Convention is to be held at Norman, Okla., under the auspices of the Alpha Sigma Delta radio fraternity. Through the courtesies of the University of Oklahoma, the committee has secured the use of the Engineering Auditorium and the Engineering Buildings in which to hold the events of the convention.

The program shows sightseeing trips to points of interest in Norman and Oklahoma City; good radio talks, traffic meetings, all the brasspounding for the boiled owls; games, stunts, prizes, etc. Strong efforts are being made to have Fred Schnell, former traffic manager and Don Mix present during the convention. E. Pat Schultz, secretary of the fraternity, 1020 Monnett Ave., Norman, Okla., will be glad to hear from you.

## Strays

8ASE suggests that the "Calls Heard" department be changed to "Calls Heard Above and Below the Bands". He has a good sized list to start it off with and believes this system should be of considerable help to the various Supervisors.

A cheap way of indicating in a relative manner the plate current in the transmitter is to bolt a thin piece of transformer core material to the core of the choke coil. As the current through the choke varies, the intensity of the vibration of the reed will change and so vary the intensity of the sound produced by it. While it may not be accurate, it's lots cheaper than a milliammeter.

—*9EHR*

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While most everyone is familiar with the Weston model 489 portable double range voltmeter, it is probably not so well known that similar meters may be obtained for use on alternating currents. The a.c. meters are of the same external shape but differ in color, being moulded of red bakelite to distinguish them from the black d.c. meters. They may be had in ranges of 150/15, 300/150 and 600/300 volts. The same model meter (528) may be had in 1-, 3-, 5-, 10-, 20-, and 30-ampere sizes.

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When using mercury arc rectifier tubes, it is necessary that the positive of the keep-alive circuit be connected to the largest or bottom electrode if a long life is to be obtained.

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We are told by 8CYM that although the screen door spring is useful to take up shrinkage in a rope halyard, it rusts quickly and snaps. He recommends robbing the springs from the baby's swing. They are so constructed that they are compressed when a pull is exerted on them and even if they do break, the whole works won't come down.

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The 1927-28 edition of the *Official List of Radio Stations in the Dominion of Canada* which contains particulars of every licensed transmitting station in Canada including ship, coast, broadcast and *amateur* stations may be obtained from the Office of the Director of Radio, Department of Marine and Fisheries, Ottawa, Canada. The complete list and binder is 50 cents and the list alone sells for 25 cents. Supplements to complete the list will be forwarded free of charge as they are issued.

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Announcement of the marriage of Miss Helen C. Hinchcliff to Harold A. Snow of the Radio Frequency Laboratories at Boonton, N. J. has just been received. Congratulations and best wishes from us all.

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8CEO has been using a pair of UX-281 rectifier tubes to supply the plate of a 203-A. Even though there are 1200 volts on their plates they don't seem to have any difficulty in handling all the current needed by the 203-A.

# Prizes for International Test Winners

FROM present indications, the total value of the apparatus prizes to be awarded at the conclusion of our February International Tests will lie between $4,500 and $4,000. As the prize list is receiving some additions at this writing, it is impossible to estimate the exact value. Our good friends of the radio industry are responsible for the generous prize awards which it gives us pleasure to list herewith. The American Radio Relay League acknowledges with a great many thanks the fine response and the expressions of interest and cooperation which were received from the individual contributors to our competition. The donors express the hope that our Tests will be successful and enjoyable to the participants as well as that they may be fruitful in advancing the communication art. The writer hopes that the Tests will be helpful to the radio industry as well as that every contributor may get back in good will and sales many times the value of his prize. Again, many thanks to you all!

It is going to be *some* job to donate $4,500 worth of prizes in a way that is satisfactory to everybody while handling the numerous other details in connection with our Tests. It will be impossible to make up the groups of prizes until the conclusion of the contest when results have been tabulated and the number of awards depending on the number of countries and amateurs participating is known. There will doubtless be between fifty and sixty prize groups —a *grand* prize to the station in the United States and also the station in Canada with the highest total score—25 prizes of different values for the 25 highest scoring stations in the U. S. or Canada considered together—suitable prizes for stations which are the only stations to score with a particular foreign locality—a prize for the highest scoring station in each locality outside the U. S. and Canada (localities partitioned from the list of I.A.R.U. intermediates).

For full information on the contest, see the following references: Page 31, 32 and 33, December 1927 *QST*, page 51 and 82 January 1928 *QST*. Remember the dates of the fourteen day contest—not so far away now (Feb. 6, 1928 0000 GCT to Feb. 20, 1928 000 GCT). Attention is also called to an error appearing on page 82 January 1928 *QST*, the paragraphs (3) and (4). Giving a reply test message to a U. S. or Canadian station raises the score *two* points (not three). It is probable that stations in foreign localities can add *three* points (not four) to the score for each U. S. or Canadian QSO after the first, providing stations entered in the test are worked instead of others not equipped with test messages. Logs are required from *everybody* who takes part, whether that part be great or small. They should contain the information specified in the rules. U. S. and Canadian entrants are provided with suitable log forms on which a full record may be kept as required. It is necessary for foreign amateurs to make up their own log sheets to contain this information. Remember, not a single station in any locality whatsoever may receive prize awards or honorable mention in *QST* unless we have the log and also copies of test messages handled during the contest.

Every amateur in the world with a short wave station is invited to participate and stands equal opportunity to win some of the valuable prizes. From what we hear, some of the fellows with UX210 transmitters are planning to run rings around the high-powered 40-meter stations by using 20 meters, where power is a minor consideration. U. S. and Canadian stations must have their entry cards on file at Contest Headquarters on or before February 1 in order to take part—there has been plenty of advance notice in *QST* as well as in broadcasts and bulletins to give everyone opportunity to enter. For stations in localities outside the U. S. and Canada to take part, it is only necessary to get on the air during the tests, working as many "nu" and "nc" stations as possible, and handling test messages.

As for the prizes, each prize or prize group is of considerable value. Groups of condensers, resistors, tubes and coils of various descriptions together with plate and filament supply units, receiver kits, etc. will be made up so that each group will be as useful as possible to the recipient. There will be single prizes of great value, too—complete broadcast receivers, complete short wave transmitters and receivers with the latest accessories — B-eliminators — A.C. tubes—chokes. A list of the donations giving the name of the donor, description of apparatus, and value follows. This is as complete a list as may be prepared at the date of writing.

—*F. E. H.*

PRIZE AWARDS

Operadio Mfg. Co., Chicago, Ill. $375.00
50 Operadio Bloc Tone Chambers, model 54. Made of Stonite, they contain a 54 inch air column. Dimensions only 12" x 14" x 6¾" Exponential air column is cast in a monolithic structure prohibiting vibration. Designed for speaker units of a 2" to 3" free diameter.

F. R. Pray & Co., Boston, Mass $300.00
300 Somerville dials, silver-plated and lacquered brass

with calibration space and vernier grip knob 3 in. diameter; Dials fit ¼" shaft; 600 bakelite knobs (to match dial). These knobs fit 3/16" shaft but have heavy brass bushings which may be drilled to ¼".

Silver-Marshall, Inc., Chicago, Ill. $277.00
10 type 242 modulation transformers; 10 type 240 audio transformers; 4 type 635 shortwave receiver kits, 18-150 meters, 4 coils and instruction booklet supplied; 3 sets of power equipment consisting of type 328 full wave power transformer and type 331 Uni-choke filter system, trans. wndg: 2-550v, 2-7½v, 1-1½v.

Federal Radio Corp., Buffalo, N. Y. $275.00
Choice of EIO Ortho-sonic 6 tube broadcast receiver, for battery operation, or EIO-60 set operated from light socket. Balanced circuit, single control, extremely selective, illuminated scale, cabinet of genuine mahogany with walnut inlay, escutcheon plate of dull gold with knobs to match. Length 27½", depth 13½", height 11¾". In EIO-60 current supply equipment eliminates all batteries.

Federal Brandes, Inc., Newark, N. J. $195.00
Model 8A Kolster Radio 8 tube broadcast receiver. This table model in satin finished mahogany cabinet contains four stages of tuned r.f., detector, and three special audio stages. It has single illuminated control. Selectivity and sensitivity adjustable. Power tube may be used in last stage. Height 12½", width 27 1/8", depth 14¼".

Aero Products Co., Chicago, Ill. $164.75
Two 250W Aero 250 watt transmitter coils; Three 204OK Aero transmitter kits (16.5-52 meters); Six LWT125 Aero short wave receiving kits; six C60 Aero Noskip r.f. receiver chokes; Six C248 Aero transmitter r.f. chokes; one Aero short wave foundation unit (drilled and engraved 7 x 18 panel, baseboard, and circuit blue-prints).

Radio Engineering Laboratories, L. I. City, N. Y. $139.50
One No. 139 type TR75 tuned plate-tuned grid transmitter, completely wired and tested, less UX852; one set type S inductances (two transmitting coils with glass coupling rods); one No. 133 short wave plug-in receiving coil kit (15-107 meters with 100 mmfd. condenser), one No. 129 UX852 holder.

Eastern Radio Institute, Boston, Mass. $120.00
One complete scholarship in the Radio Theory and Operating Course at the Institute. A fine opportunity to obtain a commercial ticket. Must be used by winner himself who may enter Institute anytime during 1928 he sees fit.

Atwater-Kent, Philadelphia, Pa. $112.00
Model 37 self-contained a.c. set. Uses six a.c. tubes and one rectifying tube and runs from 110v 60 cycles a.c. Shielded cabinet and power supply, single dial control, volume control, choice of two color combinations in satin finish Hight 7 1/8", width 17¼". Also Model E speaker in any one of five color combinations.

The Magnavox Co., Oakland, Calif. $105.00
One type R4 dynamic speaker or power cone unit, 12-ohm field requires ½ ampere at 6 volts; one type R5 dynamic speaker unit, 2500 ohm field takes 40 to 80 mils from 110 v.d.c. The 40-henry field can replace one choke of filter system in A.C. sets. Fine Magnavox units for radio or electrical phonograph work.

Ward Leonard Electric Co., Mt. Vernon, N. Y. $100.30
5 vitrohm resistor kits (8 two-inch resistors, tota'ing 21,750 ohms), 6 grid leaks (5000 ohms, 200 watts dissipation, 200 mils max.); 7 11-step vitrohm rheostats for transformer primary input control (20 ohms 60 watts dissipation, 2 amps, max.); 1 center-tapped resistor (200 ohms, 100 watts dissipation, 220 mils max.).

A. H. Grebe & Co., New York City $100.00
Grebe CR-18 short wave receiver complete with 5 coils. See full description in June 1926 *QST*, page 24. Range 10-200 meters, plug-in coils, SLF condensers, and other desirable features.

Electric Specialty Co., Stamford, Conn. $90.00
Item 8 motor-generator set with motor end wound to requirements of winner. Output 500 volts, 150 watts. Two-bearing, wick-oil type with field rheostat included.

Burgess Battery Co., Madison, Wisc. $75.00
12 No. 21308 45 volt Burgess Super B batteries, 16 lbs. each, 4¼" x 8¼" x 7⅝"; four No. 2308 45 volt Burgess B Batteries, 9½ lbs., 3⅛" x 8 1/16" x 7".

Bremer-Tully Mfg. Co., Chicago, Ill. $68.50
Two improved short wave receiving kits; two sets of Bremer-Tully audio couplers; two sets of S. F. 13 and S. F. 17 condensers.

National Co., Inc., Malden, Mass. $66.00
Four type T M 450 transmitting variable condensers —.00045 mfd., 3/16 in. spacing, equipped with type A vernier dials.

Heintz & Kaufman, San Francisco, Calif. $65.00
900 cycle, 200 watt plate supply unit. An m.g. set with quarter h.p. motor for a.c. or d.c. Includes 900 cycle transformer. Output 1500 volts—750 each side of center tap. Engraved plate with name of winner and suitable inscription is included on m.g.

Cable Supply Co., Inc., New York City $60.00
Three sets of SPEED Super Emission Radio Tubes in types that may be selected by the winners.

C. E. Mfg. Co., Providence, R. I. $55.00
Six M-26 a.c. amplifier, 2 N-27 a.c. detector, 2 R-81 half-wave rectifier and 2 R-80 full wave rectifier.

The Crosley Radio Corp., Cincinnati, O. $55.00
One battery-operated Crosley Bandbox broadcast receiver, model 601. Six tube, single illuminated control, shielded, Brown crystalline finished metal cabinet, 17¼" x 7⅝" x 5½".

The Q.R.S. Music Co., Chicago, Ill. $54.75
Q.R.S. tubes: six 201-A type; one 200A-type; one 112-type; one 171-type; rectifier; one 85 mil. 200 v. full wave rectifier; one 100 mil. 350 v rectifier; one 100 mil. 550 v. rectifier; one 400 mil. for eliminators.

Hoyt Electrical Instrument Works $54.00
(Burton-Rogers Co.) Boston, Mass.
Six Hoyt type No. 508, flush mounting milliammeters, case diameter 2¼", flange diameter, 3"; range 0-200 mils. Black finish with white hand-calibrated scales.

Raytheon Mfg. Co., Cambridge, Mass. $50.00
Four Raytheon-H full wave rectifier tubes with 150 milliampere capacity, maximum anode voltage, 600; four Raytheon-280 full wave rectifier tubes, 125 milliampere capacity, maximum anode voltage 350 R.M.S.

The Allen D. Cardwell Mfg. Corp., $50.00
Brooklyin, N. Y.
Material to be selected by winner from standard Cardwell products as one prize not to exceed value stated.

American Mechanical Laboratories, Inc., $50.00
Brooklyn, N. Y.
Power Clarostats, dissipation 40 watts; three 0-10 ohm range, three 25-500 ohm range, four 200-100,000 ohm range, four volume control Clarostats 0-500,000 ohm for receiving set applications; four standard universal range 0-5 million ohms, dissipation 20 watts for power units and receiver applications.

Sprague Specialties Co., Quincy, Mass. $50.00
Credit letter extending choice of any Sprague products, such as midget condensers and tone controls.

E. F. Johnson & Co., Waseca, Minn. $49.50
One 150 mmfd. type B ball-bearing transmitting condenser, with etched scale, pointer, handle and locking device, nickle finish, hard rubber insulation, large clearance between rotor and stator.

Hammarlund Mfg. Co., New York City $48.00
Six 20 inch long 3"dia. coils. Nr. 16 wire, 10 turns per inch.

Wireless Specialty Apparatus Co., Boston, Mass. $47.50
Twenty-five Faradon UC-49OA, 1 mfd., 100 d.c. or 500 a.c. volts max. filter condensers.

L. S. Brach Mfg. Corp., Newark, N. J. $45.50
Ten lightning arrestors; Five B. S. Electric Soldering Irons, 24 phone plugs; 12 cord connectors.

Carter Radio Co., Chicago, Ill. $44.20
Six No. 110 power switches for 110 volt circuit, quick break; six No. 2 IMP Battery switches; six .002 mfd. condensers; six No. 10 Tip Jacks; six Y 5 M resistors (500 ohms, 40 watts); six Y1OM resistors (10,000 ohms, 40 watts); six HW 75 HI-WATT 75 ohm rheostat, 20 watts dissipation.

All-American Radio Corp., Chicago, Ill. $42.00
All-Amax Senior 3 tube reflex kit.

Scientific Radio Service, Mt. Rainier, Md. $40.00
One 80 meter and one 150-170 meter quartz crystal.

The Formica Insulation Co., Cincinnati, O. $40.00
Ten panels of black Formica 7" x 21" x 3/16"; thirty pieces of tubing 2 inches O.D. by 2½ inches long, or size specified by winner.

National Radio Tube Company, San Francisco, Calif. $40.00
Pair of Rectobulbs (3000 volt rectifier, 10 volts filament); Set of plug-in Inductrons, UX base (Vacuum sealed receiving coils for 10-20-40-80 bands).

Electrad, Inc., New York City $37.50
Fifty 100 ohm center tap resistances, type V100

Halldorson Co., Chicago, Ill. $36.00
Set of super-het transformers (2 audio, 1 output, 3 intermediate).

E. F Johnson Co., Waseca, Minn. $36.00
Type B, 100 mmf. ball-bearing transmitting condenser with scale, pointer and handle.

Kokomo Electric Co., Kokomo, Ind. $35.00
Type 2 B-eliminator for sets having not more than 8 tubes (110-v-60c).

Thordarson Electric Mfg. Co., Chicago, Ill. $34.00
T-2098 transformer and T-2099 Choke Unit for full wave power supply for 2 UX-210's.

The Electric Storage Battery Co., Philadelphia, Pa. $31.90
One Model 3A 6-volt A power unit. (Trickle charger providing storage battery A power).

Tobe Deutschmann Co., Cambridge, Mass. $28.00
Two type 2020, 2 mfd., 2000 volt filter condensers.

National Carbon Co., New York City $25.00
Case of 5 No. 486 Eveready Layerbilt 45 volt "b" batteries.

C. K. Dodge, Mamaroneck, N. Y. $25.00
Ten copies of "Intensive Speed Practice", (method of increasing code speed and proficiency).

Hardwick, Field, Inc., Newark, N. J. $25.00
Two 5000 ohm center-tapped mounted transmitting grid leaks, 25 watts continuous rating; two sets of five resistors, each unit rated at 20 watts, ranges between 1000 and 10,000 ohms.

Gold Seal Electrical Co., New York City $24.00
Complete set a.c. tubes; one type GSY 227 detector, and six type GSX 226 amplifiers.

Weston Electrical Instrument Corp., Newark, N. J. $23.00
One model 425 Thermo Ammeter, Milliammeter, or Galvanometer; one model 476 a.c. voltmeter or ammeter. Ranges and types to be selected by winner.

General Radio Co., Cambridge, Mass. $22 00
Type 358 wavemeter with four coils (Range 14-224 meters).

Leach Relay Co., San Francisco, Calif. $21.00
One PR5 and one PR9 relay,—straight relays designed especially for tube transmitters.

American Transformer Co., Newark, N. J. $20.00
Pair Amer-Tran DeLuxe Audio transformers.

Marathon Battery Co., Wausau, Wis. $20.00
Four No. 3081 Marathon Super-Power "B" 45 volt Batteries.

Ensall Radio Laboratories, Warren, Ohio $18.50
Set of Item 68 coils (Six inductances for 15-210 meter super-het).

Metro Electric Co., Chicago, Ill. $18.00
Metrocone table model speaker.

Herbert H. Frost, Inc., Elkhart, Ind. $16.85
One each; Remler SLW .0005 mfd. var. condenser; Remler illuminated drum dial; ten ohm Frost metal frame rheostat; 25 ohm Frost bakelite rheostat with fil. switch; 200,000 ohm Frost variable resistor; 500,000 ohm Frost variable potentiometer with switch; single open circuit Frost Gem-Jac; pair Frost cord tip jacks.

Pacent Electric Co., Inc., New York City $15.00
Two Pacent No. 27 shielded input tranformers.

Palmer and Palmer, Buffalo, N. Y. $15.00
Varioloop (Variometer type loop antenna) with base.

R. Wood, Corona, N. Y. $15.00
900 cycle dynamotor, input 16 v.d.c. output 120 watts, 120 volts, wt. 15 lb.

Radio World Time Clock, Brooklyn, N. Y. $13.75
Three clocks (time in all zones at a glance) One leather with note pad, one plain leather, and one for panel mounting.

J. H. Bunnell & Co., New York City $13.50
Bunnell heavy duty "Gold-Bug". (Automatic transmitting key).

Elkon Works, Inc., Weehawken, N. J. $13.50
One Elkon 3 ampere "A" battery charger.

Seattle Radio Laboratories, Seattle, Wash. $12.50
Type 106 wavemeter (15-110 meters) with 2 coils.

Utility Radio Co., East Orange, N. J. $12.50
200 watt plate-filament transformer. (Two 7.5 volt, one 1100 volt winding, each center-tapped).

Jewell Electrical Instrument Co., Chicago, Ill. $12.00
Pattern 64 flush type h.f. ammeter, ranges up to 15 amperes as chosen by winner).

X-L Radio Laboratories, Chicago, Ill. $12.00
Three Model N Vario-densers, 3 Model G Vario-densers, and 3 of seven sets Binding Posts.

Jefferson Electric Mfg. Co., Chicago, Ill. $12.00
Two Concertone audio transformers. Excellent tone range.

Belden Mfg. Co., Chicago, Ill. $12.00
1 Beldenamel Aerial Kit, and 5 fused battery cables.

Corning Glass Works, Corning, N. Y. $11.40
Four 7¼ inch PYREX transmitting insulators; twelve 3½ inch PYREX receiving insulators.

Mueller Electric Co., Cleveland, Ohio $11.00
Assortment of 100 Universal helix and battery clips.

Radiall Co., New York City $11.00
10 Amperites with mountings. (Automatic filament control).

James Radio Curtis & Robert Curtis for the Curtis Sales Co., Ft. Worth Tex. $10.50
Curtis-Griffith 250-watt power-filament transformer, 350-550 v. each side of c.t.

(*Continued on Page 44*)

# The Final Capacity in a Two-Section Low Frequency Filter

By D. E. Replogle* and James Millen†

This is the 2nd of a series of articles on the practical design of filters and filter parts. These articles are written by members of the Raytheon organization and are based on the extensive experience of that organization in the handling of the problems that arise in the manufacture of filters for a wide variety of needs. The third article will follow shortly.—Technical Editor.

ALTHOUGH it is a rather well known fact that the value of each of the capacities, $C_1$ $C_2$ and $C_3$ in (Fig. 1) a B-power supply unit has some effect upon the effectiveness of the filter, as far as ripple suppression is concerned there is no written information generally available as to just how effective these different condensers are. In fact, about the only material published on the subject so far, other than the first article of this series, was some brief remarks of Prof. Dellenbaugh's quoted on page 29 of the February, 1926, *QST*. His remarks on the subject may be summarized with equal brevity by stating that: "The prime function of the initial filter condenser $C_1$, is voltage regulation; of the middle condenser $C_2$, ripple suppression, and of the final condenser $C_3$, audio quality control.[1] The value of any one of the three condensers has some effect upon the percentage ripple in the finally output, but changes in $C_2$ produce a much more marked change in ripple value than changes of either $C_1$ or $C_3$."

Thru the facilities available at the Raytheon Laboratories in Cambridge, Mass., the writers have been able to investigate in a quantitive way, just what effect changes in capacity of $C_1$ $C_2$ and $C_3$ have upon the general excellence of a B-power filter circuit.

In the September 1927 issue of *QST* the function of $C_1$ was considered. At this time, $C_3$ will be considered. In the near future a paper on $C_2$ will be presented followed by a final paper treating simultaneous changes in capacitance of $C_1$ $C_2$ and $C_3$.

The purpose of these papers is to present data to guide B eliminator designers with a limited amount of total filter circuit capacity at their disposal in the distribution of this capacity between $C_1$ $C_2$ and $C_3$ so as to produce the best results.

The first step taken in the investigation of the effect of the capacitance of $C_3$ on the a.c. ripple or "hum" in the power unit, was to construct a conventional Raytheon type power unit in which any value of $C_3$ between 0 and 30 μfd., could be readily secured.

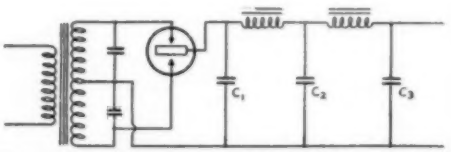


FIG. 1. RAYTHEON PLATE-SUPPLY SYSTEM USED IN THE INVESTIGATION

Across the output of the power unit was then placed a resistance load which drew 90 m.a. A cathode ray oscillograph, with "bucking" battery to balance out the d.c. voltage component was then connected across the resistance load as shown in Fig. 2. By varying the value of $C_3$ with a constant load of 90 m.a. the different oscillograms in Fig. 3 were obtained.

The curve in Fig. 4 showing percent ripple in the output was then obtained from the oscillograms in Fig. 3. This curve was then checked by the use of a vacuum tube voltmeter in place of the oscillograph.

But let us see how this curve checks up with the conventional filter circuit specifications? Generally the arrangement is 2, 2, 8 μfd. or, with many of the more recent eliminators 2, 3, 6 μfd.

We find from Fig. 4 that as $C_3$ is increased in value up to 6 μfd. there is a constant and very marked reduction in ripple value. Still further improvement results between 6 and 8 microfarads, but not as marked as before. In fact, there is even something to be gained by increasing $C_3$ up to 10 microfarads. After 10 microfarads is reached, however, very little further reduction in ripple results. It would seem therefore, that a good value for $C_3$, as far as ripple is

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1. The "audio quality control" can be explained by considering that the audio-frequency variations in the plate currents of the tubes must be supplied by the final condenser $C_3$. If $C_3$ is not adequate the full a.f. variations cannot occur, the peaks are clipped and harmonic distortion results.

In a transmitter plate supply we usually have but two condensers, the second one to a degree combining the functions of $C_2$ and $C_3$.—Tech Ed.

concerned, would be 8 μfd. with an allowable variation of plus or minus 2 μfd., which is exactly the practice adapted by the different manufacturers of the Raytheon approved power units.

But let us get back to the prime function of the final filter capacity of the B-eliminator—the control of audio quality.

Suppose, for instance, that there is a sudden demand for a fairly large amount of

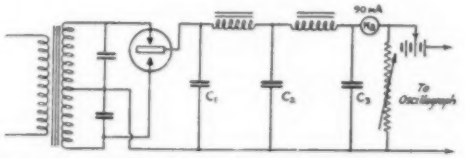



**FIG. 2. SETUP USED IN OBTAINING OSCILLOGRAMS OF FILTER PERFORMANCE**

**The variable resistance is used as a load. The bucking battery prevents direct current from going to the oscillograph but passes the A.C. component freely.**

additional energy from the B-eliminator, as would occur with the placing of a low frequency signal voltage of even average magnitude on the grid of the power tube. Due to the large time constant of the filter circuit, the variations in current required for the receiving set cannot be obtained through the filter chokes. In other words, the rectifier and filter, less the final condenser, must together be considered as a constant current device. The variations in energy required, must be taken care of, then, by the final or storage condenser. In such a case, when an increase of current is required, the condenser voltage will begin to fall off. Just how much the drop in voltage will amount to will depend entirely upon the increase in current demanded and the length of time thorugh which the demand exists. Thus, the worst conduction will be with a low frequency audio signal on the grid of the power tube. Here the time is long and the current change large.

Dellenbaugh, in his thesis on filter circuits states that the approximate variation under very bad conditions may be obtained by considering that a signal is received upon the grid so as to instantly reduce the plate resistance by some given amount; and that the signal then maintains this apparent resistance at a fixed value for a definite period of time. This period of time will never be more than one-half cycle; and, therefore, at fifty cycles it will be equal to 0.01 second. This half-cycle time will be called $t$. Since the change in tube resistance will reduce the voltage drop, the difference between the previous voltage, which we will consider the average delivered, and the resistance drop in the tube will be the condenser voltage available for reducing current.

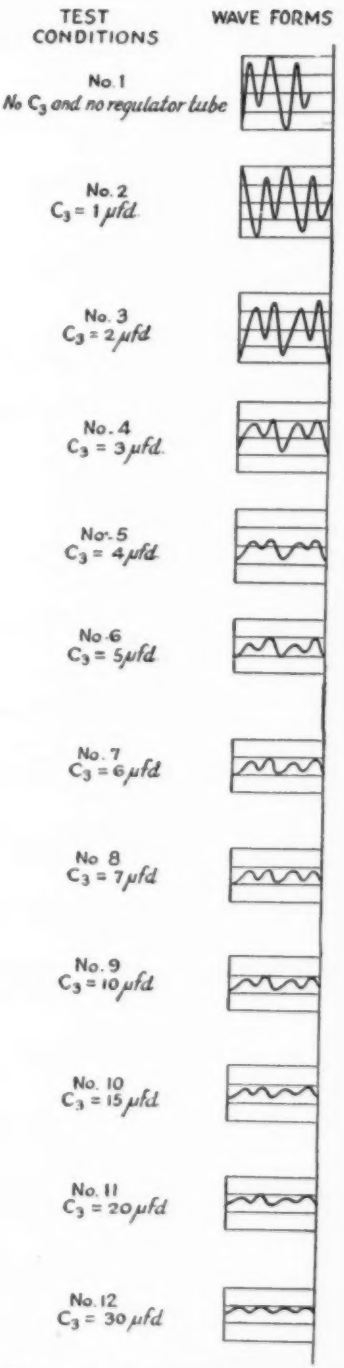



FIG 3 – OSCILLOGRAMS OBTAINED FROM THE CIRCUIT OF *FIG. 2*

NOTE: *Load current in all cases 90 Ma.*

$t$ = .01 seconds for ½ cycle at $f$ = 50
$E_{dc} - \Delta E$ = Condenser voltage difference upon arrival of signals.

$$V = (E_{dc} - \Delta E)\left(1 - \varepsilon^{-\frac{t}{RC}}\right) + E_{dc}\,\varepsilon^{-\frac{t}{RC}}$$

$t$ = .01
$E_{dc} - \Delta E$ = 50
if $E_{dc}$ = 150
and $R$ = 5000
and $C$ = 4 μfd.

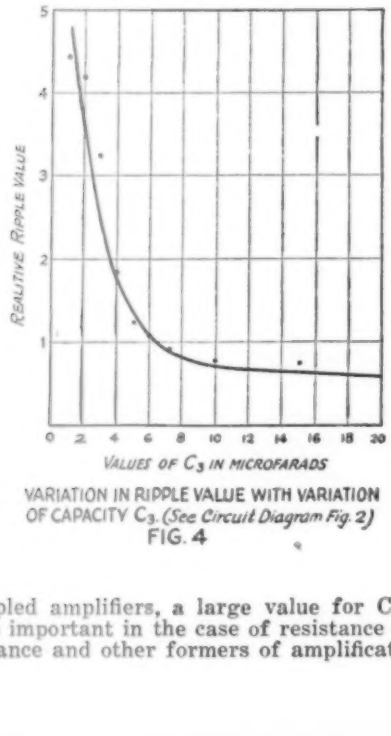
$$\text{then } V = 50\left(1 - \varepsilon^{-\frac{.01}{.02}}\right) + 150\,\varepsilon^{-\frac{.01}{.02}}$$

= 110 volts at end of period

but if $C$ = 20 μfd.
then $V$ = 140 volts at end of period, only 10 volts below the normal 150.

Thus in the one instance, the variation in voltage amounted to 27% and the other but 7%. While the drop in one case is rather extreme, it is given to show just what a marked effect the value of $C_3$ really has on maintaining a constant voltage supply to the receiving set. Experimentally it has been found that with present high grade broadcast receivers using the UX-171 type of power tube that a minimum allowable value for $C_3$ commensurate with good reproduction is approximately 6 microfarads, and that slight improvement can be noticed as this value is increased up to about 10 μfd.

While, as previously mentioned, the above discussion applies but to transformer coupled amplifiers, a large value for $C_3$ is also important in the case of resistance impedance and other formers of amplification requiring constant current rather than constant voltage. Should the value of the terminal condenser in such instances be unduly small, oscillation will occur as a result of the common coupling due to the filter choke coils.




VARIATION IN RIPPLE VALUE WITH VARIATION OF CAPACITY $C_3$. (See Circuit Diagram Fig. 2)
FIG. 4

An attempt was made to determine the "equivalent capacity" of the 3-element gaseous Raytheon regulator tube.[2] (This type of voltage regulator tube eliminates the necessity for $C_3$.)

Two B power units of identical construction, except for $C_3$, or its equivalent, were connected as shown in Fig. 5.

Since the two power units are similar, their output should be similar with respect to ripple when $C_3$ has such a value as to produce the equivalent filtering action of the regulator tube. As the outputs are bucking each other, any ripple common to

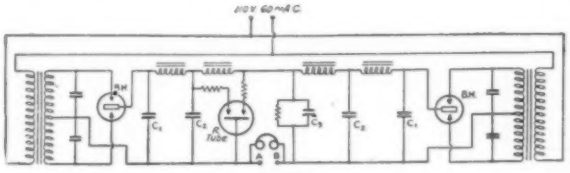
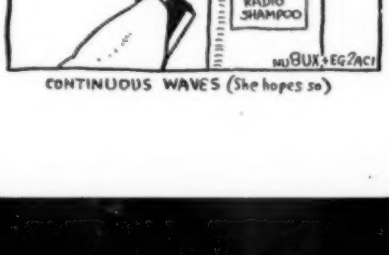



FIG. 5

both power units will be balanced out (180° out of phase). If, then, the capacity of $C_3$ is varied until the minimum hum is heard in the phone, the equivalent capacity of the regulator tube will be equal to the value of $C_3$. As a result of tests with a number of different rectifiers and regulators in this circuit, an equivalent capacity of between 20 and 60 microfarads was obtained for a regulator tube of the Raytheon type. This apparently wide variation does not indicate a large variation in the action of the different regulator tubes, but, as will readily be seen from the curve in Fig 4, that any capacity between 20 and 60 microfarads has essentially the same effect upon the ripple value.

2. This tube works in a manner somewhat resembling the operation of the UX-874 regulator tube previously described in *QST*. The presence of a third electrode and a different system of connecting across the full system voltage thru limiting resistances shows that the parallel cannot be carried far. —Tech. Ed.




CONTINUOUS WAVES (She hopes so)

# Experimenters' Section Report

THE Section has this time furnished us with three problem-reports, of which we hope to have at least two in this issue, though only one may appear in the section report. The reports in question are as follows:

| | |
|---|---|
| Problem T-30 | A 5 Meter Experimental Station, Norvell Douglas. |
| Special No. 2 | A Portable Transceiver, Herman Radloff. |
| Special No. 1 | A Low-Power Master Oscillator Power-Amplifier, Beverly Dudley. |

One of these articles will be found below, the choice of the particular one being largely a matter of magazine make-up. The others will be found elsewhere in this or the following issue.

Lansingh & Stuedle,
Short Wave Radio Engineers,
Box 731, Hollywood, Cal.,
Dec. 28, 1927.

Experimenters' Section,
A.R.R.L., 1711 Park St.,
Hartford, Conn.

Gentlemen:

This is an open reply to Mr. Nightingale's letter on page 48 of January *QST* which I have just received. First, I want to thank Mr. Nightingale on behalf of the OWLS Committee; practically all letters received by 9XL, 1XM or the "X" Section regarding Standard Frequency signals pass through my hands sooner or later and I can testify that such letters are more welcome than a dozen "ur std. freq. sigs hrd hr" cards.

This question of accuracy will become increasingly important when our band widths are cut down, so I feel justified in taking space with the question where otherwise I would not do so. Mr. Nightingale observes "I much prefer the tone modulation now used on these S.F. transmissions to the pure CW used before, although I do think that the pure CW allowed a greater percent of accuracy on attaining true zero beat in the receiver". This is undoubtedly true, and I can congratulate Mr. Nightingale on considering the question of accuracy at all which is more than most amateurs do. But note the following:

In utilizing standard frequency signals, *it makes no difference at all whether or not you have the receiver at zero beat with the incoming signal!* The explanation is quite simple for those who happen to be interested in the *why*. Consider 9XL is transmitting on 40 meters; this is 7500 K.c. or 7,500,000 cycles per second as any table will show if you don't know how to figure it. Now, the accuracy which we try to reach (and exceed if possible) in OWLS-SF signals is 0.1 of 1%. One-tenth of one per cent is then 7500 *cycles*. You can now see that even if you have a beat note in your receiver of 1000 cycles (which is a fairly high note) with the incoming signal you still are adjusted to the incoming signals 7½ times more accurately than the fundamental accuracy of that incoming signal. So why worry about that zero beat? And even if the OWLS-SF should maintain a greater accuracy than they do, I'll bet I can count on my fingers the number of hams who have wavemeters capable of measuring and holding an accuracy of 0.1 of 1% on the high frequencies or short waves.

Now that our bands are soon to be so narrow and fractions of meters are becoming so important, isn't it time we dropped the wavelength designation entirely? Those who are not used to frequency, kilocycle or megocycle designations would very soon become so by exclusive use of those terms.

KILLIAN V. R. LANSINGH,
Member OWLS Committee in charge of SF.

MORE S.F. STATIONS WANTED

The OWLS Committee is interested in hearing from any persons who have crystals which are of a frequency very close to the boundaries of the 3500, 7000 and 14,000 Kc. bands that will become effective in January, 1929.

The purpose is to conduct later in the year special OWLS-SF transmissions on these particular frequencies more often than the regular OWLS-SF schedules are so that when the new allocations go into effect no one will have an excuse for not knowing where the boundaries of the new bands are. The idea, of course, is to use the crystal in a crystal-controlled transmitter. If you cannot give frequent schedules (though, unlike 9XL, each schedule would be short) your service would not be of much value; but if you have the crystal and not the time, you might combine up with someone else.

The Committee would also welcome communications from any one who has the necessary time, apparatus, and ambition to transmit schedules similar to 9XL's but on either the east or west coast. Though the Committee has no official standing outside the territory of the A.R.R.L., we would be glad to give our recommendation to the I.A.R.U. that any station outside North America be appointed an I.A.R.U. OWLS-SF, if that station is willing and able to undertake a similar service, and can give the same evidence of such accuracy and ability as we require from A.R.R.L. OWLS-SF.

Those interested in either of the above should write K.V.R. Lansingh, Box 731, Hollywood, California.

—*K. V. L. R.*

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## The 5-Meter Experimental Station 9EHT

**By Norvell Douglas***

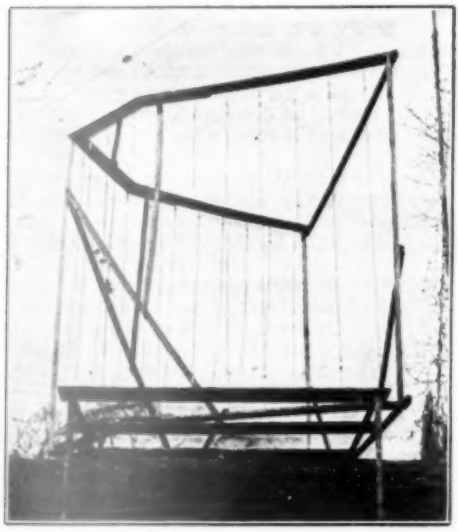
FOR several years 9EHT has been a 5-meter experimental station. Gradually this activity has pushed other radio work into the background until at present the station is purely a 5-meter one.

Earlier in the proceedings the antenna was of the usual "high harmonic" variety and while signals from this were heard very weakly on a few occasions in Connecti-

*Member Experimenter's Section, 9EHT, 1622 New Hampshire Street, Lawrence, Kansas.

cut and New York that antenna has now been replaced by a vertical "half-wave" (Hertz!!) with a reflector.

Reflector antennas are obviously impractical for amateur use on bands higher



THE REFLECTOR ANTENNA

Signals from this antenna were heard at the San Diego station of Don C. Goode by R. S. Kruse with a superheterodyne built by the author and R. S. Kruse and carried to the west coast by the latter. The reflector is mounted on a platform on top of the garage. It may be turned to any desired position in a few minutes. The feeders, which are spaced 5 inches apart on glass insulators, may be seen at the left. The antenna at the focus of the parabola is a ¾ inch copper tube 78 inches long. The antenna current is between 1.5 and 2 amperes.

than five meters, but a five-meter reflector assumed a size that is not difficult to build or handle. Also, some of the difficulties encountered on this wavelength may be obviated by the use of a properly directed beam.

Last summer I built a reflector, hoping that something more could be learned about the peculiarities of five-meter signals. The photograph and Fig. 1 illustrates the reflector. It consists of a vertical current-feed antenna worked at the fundamental, placed at the focus of a parabolic reflector of 21 parallel wires spaced one foot apart. The length of the antenna and reflector wires is one-half wavelength minus a few inches to allow for loading due to the ground and objects in the field.

The parabola has a focal length of one foot. This gives a much sharper beam for a given aperture than a focal length of one-quarter wavelength. As the focal length is made less than one quarter wavelength, the reflector wire back of the antenna is put out of phase and the back leakage is probably increased, but the advantage of a highly concentrated beam obtained with a reflector that is not too large to handle overshadows these disadvantages, I believe. Fig. 1 illustrates the argument.

The antenna feeders are spaced 5 inches apart on glass insulators. The length is not critical and they are preferably left untuned. The separation of the feeders on the antenna is adjusted of best antenna current. When working properly there should be a voltage node at the center of the antenna coupling coil and *no pronounced standing waves on the feeders.*

Fig. 3 is a diagram of the field strength indicator used to explore the field around the reflector. Due to the location of the reflector 18 feet above ground, no curves could be obtained to show the complete field. Fig. 4, however, shows the field at the aperture of the parabola and gives an idea of the sharpness of the beam.

By raising the indicator vertically in front of the reflector, curve 5 was obtained. This indicates the usual low angle radiation from a fundamental vertical antenna.

During a limited number of tests, signals from this reflector have been heard in California, Hartford and possibly New York. This does not mean messages were transmitted; the signals were merely heard.

Numerous local tests conducted here in the last three years indicate that five-meter signals behave similarly to those of lower frequency except that the ground absorption is much greater. Signals are better in clear spaces, on hills or bridges as would

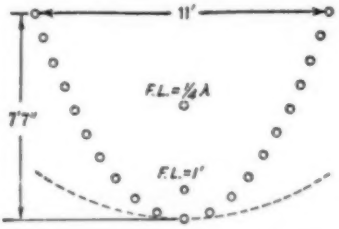



FIG. 1 ARRANGEMENT OF THE WIRES OF REFLECTOR. THE DOTTED LINE IS A PARABOLA WITH A FOCAL LENGTH OF ONE QUARTER WAVE LENGTH

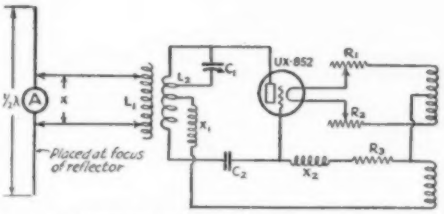
be expected, but in many instances fair signals have been received at the bottom of steep hills out of line of transmission.

THE TRANSMITTER

The Ultra-Audion circuit has always been used in the five-meter transmitters here because of its extreme simplicity. And simplicity is an essential at this wave length. As the grid-plate capacity of the tube is in series with the oscillatory circuit, a tube with low internal capacity should be

used. For this purpose the UX-852 can not be bettered for a low power transmitter. This tube in the Ultra-Audion circuit allows a relatively large primary inductance to be used, as can be seen from the photograph. The large inductance means that more energy will be put into the antenna coupling coil—and antenna where it is wanted.

The secret of success with the UX-852 is in the use of the proper grid leak. Nothing less than 20,000 or 25,000 should be used




x Separation of feeders on antenna. About 18"
$L_1$ 3 turns ¼" copper tubing. 4" Diameter
$L_2$ 2½ turns ¼" " " "
$C_1$ See photograph
$C_2$ Not less than .0002. As "low loss" as possible
$R_1$-$R_2$ Keeps center-tap balanced Wire wound-serves as r.f. chokes
$X_1$, $X_2$ See photograph, $X_1$ connected to $L_2$ at voltage node.
$R_3$ 25,000 ohms for UX 852

FIG. 2 ULTRA-AUDION 5 METER TRANSMITTER

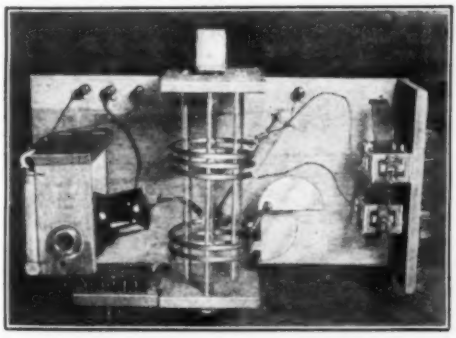
if the efficiency is to be kept high. One that will handle 10 watts is large enough. The tube shown in the photograph has been worked for hours at a plate input of 640 watts with no signs of excessive heating.

Five-meter signals are unsteady enough without any additional help along this line from the transmitter. If the filament supply is from a.c., some arrangement should be made to hold the voltage constant. Better yet, use d.c. We usually don't have much choice about the plate supply but one should use the best available. All leads should be as short as possible and rigid enough to not vibrate easily. The feeders and antenna should be pulled taut so as to cause no swinging.

### THE 5-, 20- AND 40-METER SUPERHETERODYNE

A regenerative detector and one or more stages of audio amplification can not be used to any advantage at 5 meters because such a receiver is neither sensitive or selective enough, and not being selective allows the 5 meter noise level to become terrific. Obviously the difficulties may be overcome to some extent by adding more tuned stages. Since straight r.f. amplification with three element tubes is out of the question at five meters, the superheterodyne is the only solution (not considering super-regeneration).

The picture and Fig. 7 show the receiver we are going to talk about. The circuit is an autodyne detector with resistance

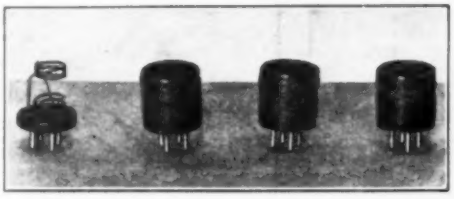


**THE FIVE-METER TRANSMITTER**

**The ultra-audion circuit is used. The plate blocking condenser is made of 12, 1¼ x 2½" copper plates spaced ¼" apart on thoroughly dried hickory strips. The tuning condenser consists of one fixed and one moveable copper plate connected across two turns of the primary inductance. A set screw enables the plate to be locked after the wave is properly adjusted. The series condensers in the antenna feeders are shown in the picture, but are not used in practice.**

control of regeneration, followed by two stages of 40 Kc. I.F., detector and two audio. Instead of heterodyning a signal at 1,000 cycles as is ordinarily done with detector and two audio alone, it is heterodyned at 40,000 cycles.

A five-meter receiver is essentially no different from a 20- or 40-meter receiver, but much more care must be used in building the former if decent results are to be



**THE PLUG-IN COILS**

**The coils from left to right cover the following bands:**

| | |
|---|---|
| A | 4.9- 5.3 meters |
| B | 23 -30 meters |
| C | 17 -23 meters |
| D | 50 -43 meters |

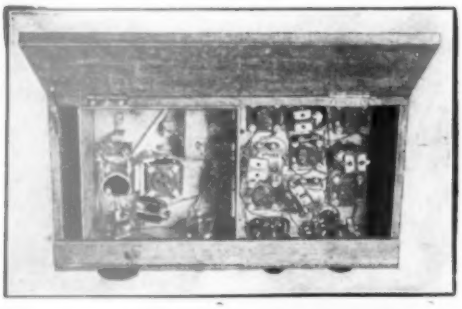
expected. Here are a few qualities that high wave receivers *may* have, but which all five-meter receivers *must* have if they are to be successful.

1. A metal panel or shield with the first detector completely shielded.

2. The first detector mounted on a sponge rubber with No. 30 leads to the

socket. The other tubes should be mounted on spring sockets. Don't overlook these features if you want to enjoy yourself while tuning a five meter receiver.

3. Noiseless resistance control of regeneration. Any other kind changes the



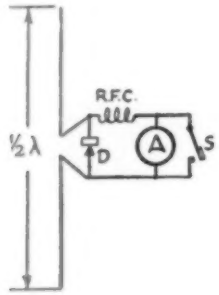
THE 5-, 20- AND 40-METER SUPERHETERODYNE
The autodyne detector is in the metal can at the left. This can has a tight fitting lid. The plug-in coils go into the socket to the left. The variable condenser to the right tunes the antenna circuit. For five meters, a long horizontal wire seems to make the best antenna. The variable resistance used to control regeneration is directly under the antenna condenser. The big honeycomb coil was used as the tuned input merely because no other kind was available at the time the set was built.

frequency and ruins ones chances of hearing signals.

4. A *good* vernier dial.

5. All leads as short as possible.

The plug-in coils allow the same receiver to be used on 5, 20 and 40 meters. Possibly the midget tuning condenser would cover the 80-meter band also. The coils are space wound on bases of defunct 201-A's. The




D *Carborundum detector*
A *0-1 Jewell milliammeter*
S *Shunt to protect meter*

FIG. 3 FIELD STRENGTH INDICATOR

diameter of the base was too large for the five meter coil so the shell was cut off and self supporting coils of No. 14 aerial wire were made. The coil was quickly adjusted for the desired band as follows: Both grid and plate coils were each given 4 turns of about one half inch diameter. One end of each was soldered to the base. The other end of each spiral made connection to the base via a small wire. With the coil in place in the receiver and the wavemeter handy, this small wire was slid around the spiral until the wavemeter indicates the desired band. At each measurement the dead end was cut off to avoid loading. The other coils were made in a similar cut-and-try manner. In the picture the grid coil is at the bottom.

At five meters, the superheterodyne handles as nicely as any 40 meter receiver. Two stages of audio can be used on the headphones as the noise level is surprisingly low. Signals from my transmitter can be heard with loud speaker volume at a distance of eight miles, while with a regenerative detector and audio they are just audible. At 20 and 40 meters the results were beyond expectations. Many distant stations seem to come through like locals. The noise level is also low enough to make high amplification possible.

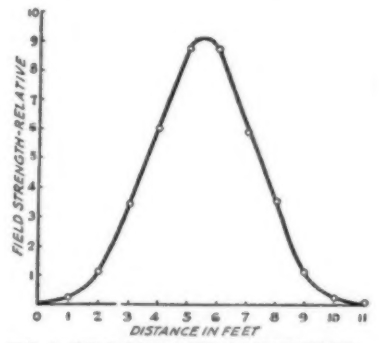



FIG. 4-FIELD STRENGTH AT APERTURE OF PARABOLA

So much for the station as it stands. Of course it would not be true Experimental station if there were not plans for the future. These plans include work with horizontal antenna in a similar reflector to the one now used, also some 24 hour tests which have been long planned but until recently not possible.

After this one naturally asks, what is the profit of all this? The answer to that is not difficult, for enough stations excuse their existence by merely providing pleasure through conversations with other radio men. The 5 meter "game" has other advantages in addition—but that is a separate story and will be told as it came to our minds after many conversations by radio, mail and in person.

# The Worthwhile 5-Meter Wave

By Norvell Douglas and Robert S. Kruse

TO CLAIM that something is worthwhile means that one must expect to be called on for a proof of the claim.

We being with the claim—

Nothing in A.R.R.L. is more encouraging or has been much more worth while than the steady pursuit of the elusive 5-meter wave by a group of our members—a group of which the present writers are proud to be members.

Very probably there will be raising of eyebrows at this, for there is a very general

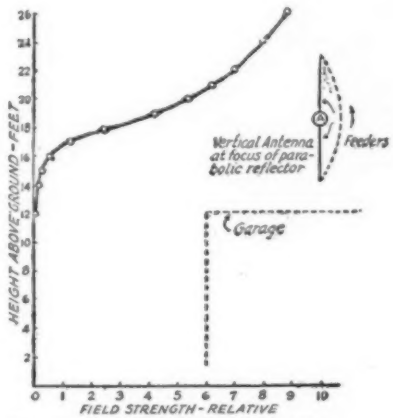



FIG. 5 - FIELD STRENGTH IN VERTICAL PLANE, 15 FEET FOCUS OF REFLECTOR

impression that "5 meters isn't good for anything". We have already said that we do not believe this, and will add that in our estimation 5 meter work has plentifully justified itself—and will continue to do so.

What is it that we expect of a waveband? What makes a new wave worthwhile?

One of the promptest answers will be—"Its communication value."

True—but a long way from complete. What, for instance, caused the opening of the whole territory below 200 meters? It was most certainly *not* a desire to operate stations down there, for everyone in the operating game (amateur and commercial alike) was dead sure that all waves below 200 were worthless and the person that tried to use them was a fool.

What actually caused the early cutting and trying at Washington and Minneapolis

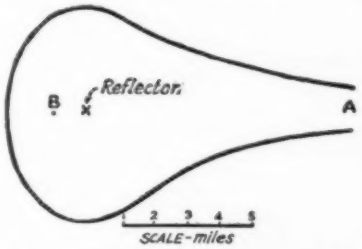



FIG. 6 - APPROXIMATE LIMITS OF AUDIBILITY OF SIGNALS ABOUT 5 METER REFLECTOR. SIGNALS MAY BE HEARD AS FAR AS 15 MILES IN LINE WITH THE BEAM AT GOOD LOCATIONS BUT WIDTH OF BEAM COULD NOT BE DETERMINED BEYOND 8 MILES SIGNALS HAVE SAME STRENGTH AT "A" AND "B".

and Lawrence and South Manchester was a *desire to know*.

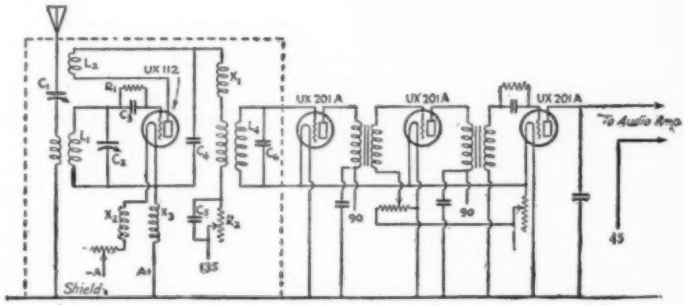
The men of this outfit who so persistently kept after the "useless" waves below 200 meters were not doing it to gain any particular benefit but purely to find out what would happen.

Enough things happened so that we scrapped all amateur radio, all theory about transmission and most of the commercial stations—and started telegraphic radio over again.

To expect such a revolution again is too much, but even now 5 meter work has paid for itself, though it receives no credit.

### WHAT HAS BEEN GAINED

How many have ever given a thought as to the causes of our better information on methods of antenna feeding, our improved r.f. chokes, our non-crystal methods of stiffening oscillators, our better ways of keying without chirps, and the presence of




$C_1$ 60 mmfd.
$C_2$ 25 "
$C_3$ 25 "
$C_4$-$R_1$ Adjusted for best operation on all bands
$C_5$ .5 mfd
$L_2$-$C_6$ Tuned to 40 K.C.
$X_1$, $X_2$, $X_3$ 100 turns on pencil
$R_2$ 50,000 ohms
$R_3$ 400 ohm potentiometer
$L_1$, $L_2$ Plug-in coils

FIG. 7

a godsend known as the UX-852 tube?

It happens that they are all by-products of the 5-meter work. As far as *QST* is concerned, the question of chokes, stiffness of oscillators, chirpless keying, antenna feeding were all of interest but not of actual vital importance at waves above the 20-meter band—until 5 was tackled. There we *had* to have better information and when it was gathered together or found out by testing the 20-meter band benefited—and to a lesser degree so did 40 and 80.

As for the 852, our own 5-meter work was followed with interest by commercial firms (remember that "our" does not mean us two alone) and in checking on the results they found the need for a tube that would behave at waves below 20 meters. After everyone had taken a shot at several sorts of tubes the 852 emerged as a general amateur utility, helpful to the 5-meter man to be sure—but very fine at 20 and also at any wave for the lover of high plate voltage!

A less tangible thing has been gained, we have learned that the final test of any notion about transmitters and receivers is to try it at 5—there the defects are magnified and we learn faster. Of course one may object that if the same things are not bad at 40 they are not worth worrying about—but many small defects add up to make a poor station and one had therefore better learn where one may.

Just one point more—the increase in fraternal feeling between the experimenters in the U. S. A. and in other countries as well has seemed to receive unusual encouragement through the 5-meter game, nothing before seems so well to have taken hold of the experimental imagination. That too is worth while.

WHAT HAS ACTUALLY BEEN DONE

In talking these things over at Lawrence and by mail we have been surprised to find how little we have said in *QST* as to the testing and trying that has been done in Kansas, in Connecticut, in New York, by Ducati in Italy, by several men in France. It occurs to us that a story somewhat summing these things up may be worth while. It will be written, and if it still seems worthwhile will be told here.

Meanwhile it is too bad that only a few "X" stations can *legally* attack the forthcoming 10-meter band at this time.

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PRIZE AWARDS

*(Continued from Page 35)*

Parmater Products, Lansing, Mich. $10.00
Transmitting coil for either 20-40 or 80 meters, or same value in other products.

Yaxley Mfg. Co., Chicago, Ill. $10.00
Two Nr. 444 Automatic power controls (Relay switch).

Leslie F. Muter Co., Chicago, Ill. $10.00
Two "Clarifiers" (audio output choke and condenser), or other Muter products of equivalent value.

Arthur H. Lynch, Inc., New York City $9.00
Resistance amplifier kit, or American tapped resistor, or heavy duty resistor.

Klosner Radio Corp., New York City. $8.75
Five sets of 5 type Universal sockets.

The Sterling Mfg. Co., Cleveland, Ohio $8.50
Sterling Model R-415 0-300 d.c. voltmeter.

Dejur Products Co, New York City $8.00
No. 110 Planofier (Resistance coupled amplifier).

Wireless Radio Corp., Brooklyn, N. Y. $7.00
Universal Panlkit (Metal panel, brown crinkle finish, 2 illuminated dials, rheostat, knobs and hardware).

Chas. F. Jacobs, Brooklyn, N. Y. $6.00
Twelve cage antenna spreaders, either 5 or 7 in. diameter.

F. W. Sickles Co., Springfield, Mass. $6.00
Three No. 30 shielded r.f. transformer coils (200-550 m.)

American Sales Co., New York City $5.70
2 Mesco Keys, 2 R.C.A. power rheostats, and 2 TB1 Kenotrons.

H. H. Eby Mfg. Co., Philadelphia, Pa. $4.50
Ten binding posts, any markings desired; six sockets either four or five prong type.

## Strays

F. A. Hill, of Bremer-Tully, suggests that when connecting the lead from the audio transformer to the plate circuit of the detector tube in a short-wave set that it go to the "throttle" condenser side of the tickler. If it is connected directly to the plate, it is quite possible that the set will not oscillate at the shorter waves because the capacity of the transformer, etc. will be in shunt to the tickler coil and may by-pass too much energy around it.

—·—·—

For those who need resistors for dropping the voltage to the power stages to a value suitable for a crystal tube use, the G. E. sell some 11,500 ohm, fifty watt, units that cost about 60 cents. They are wire wound resistors and are known as Size C, Industrial Control Units, CR9000, Form P and PM. Your local electric shop should be able to get them for you.—9DAX.

—·—·—

Two or three of the 2-candle-power, 110-volt lamps used in G. E. time switches can be gotten from most every power company at 60 cents each. They have a high resistance and will make a good grid leak for the low-powered transmitter.—9DAX.

—·—·—

High School students should go and see their Printing Instructor when they want to have some QSL cards printed. In many cases they will be able to do the job themselves.—6BWS-6BYG.

# 6AM

By Don C. Wallace* and Robert S. Kruse**

THIS IS A STORY about a type of plate supply that does not blow filter condensers, because it does not use them. The idea is not new but has had very little attention in amateur transmitting stations which is rather remarkable. We, therefore, have the feeling that the plate supply system used at station 6AM will be of interest, which feeling is supported by the interest shown by the men at the San Diego convention where the scheme was talked over in open meeting.

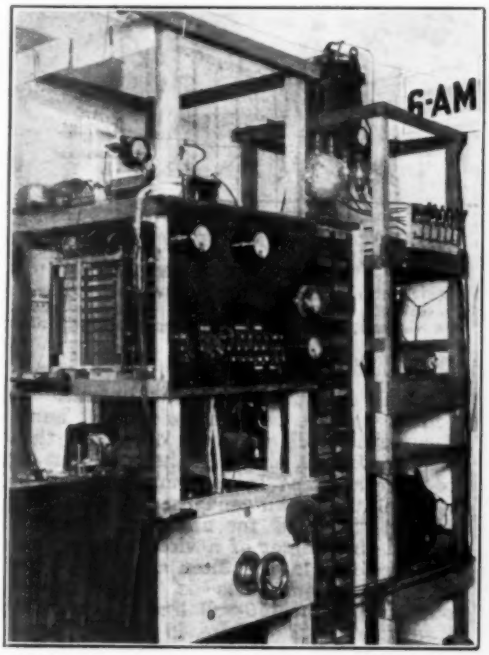
Naturally, the story falls into two parts, an explanation of the "why" of a system that seems rather complex at first and the description of the apparatus and its performance at 6AM. The second part of the story is naturally best told from personal experience at 6AM, therefore, you may be able to see joints in the story where we have put together the part written at Long Beach and the part written at Hartford.

Before going to an explanation of the meaning of the term "3 phase" we can gain clearness by thinking over the things we expect from a perfect plate supply. They are about as follows:—

1. Reliable operation without replacements or attention.
2. Good regulation, i. e. steady voltage.
3. A good heterodyne note-distinctive if possible.
4. Reasonable cost.
5. Ability to carry various loads.
6. Reasonable compactness.
7. Silent operation.

All of us will agree that none of our ordinary plate supplies pass all of these requirements, especially not the ones of reliable operation and good regulation. Let us see how and why they fail.

Usually we use 60-cycle supply current. We feed it to a transformer, step the voltage up, go thru a "full-wave" rectifier, then to a filter and finally to a set. If the voltage is below 1000 we have little to worry about, it is only necessary to make any of the ordinary systems amply big. If the voltage goes above 1000, the rectifier and filter both become troublesome. Certain of the rectifiers (electrolytic and gaseous) refuse to work well. The condenser of the filter system becomes quite expensive, causing us either to economize on the capacity and put up with bad regulation or blow condensers. (Of course we usually claim that the condenser was no good and write hot letters to the advertising manager—but secretly we know that it wasn't right to put 1500 volts a.c. plus key surges on a "1500 volts d.c." condenser.)




**THE OSCILLATOR FRAME (LEFT) AND POWER PANEL (RIGHT)**

**The Lewis water-cooled tube is unfortunately not visible though its discharge tube and the glass telltale in the waterline may be seen. The top deck holds the secondary inductance, filament transformer and primary coil. The tube hangs somewhat lower and on the next level is the large special V.C. The tuning cards are at the top of the frame. Each frame is 6½ feet high but only 24" square so that ample room is obtained with small floor space.**

On top of all this there is the difficulty that *any* filter has an output voltage that changes with the load. When the key is up the filter will charge to the very peak voltage (1.4 times the ordinary transformer voltage) and when the load comes on (See Fig. 1c) this voltage will drop to some uncertain point that depends on the current drawn, the filter resistance, drop thru the rectifier, size of the filter condensers and a few other things. To keep the note inside the township we must use crystal control

*6AM, 279 Molino Ave., Long Beach, Cal.
**Tech. Ed. *QST*.

with its attendant complication and inflexibility, or at least use a large C/L in the tuned circuit with probably some sort of a load resistance to "waste the peak" and keep the voltage within reason. Now, would

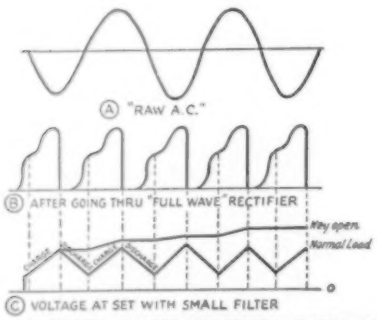



**FIG. 1. CURVES TO SHOW HOW A "FULL WAVE SINGLE PHASE" MERCURY ARC RECTIFIER WITH FILTER OPERATES**

**Note that the output of the rectifier is anything but the smooth and beautiful curve ordinarily shown. The voltage curves of C are rough approximations only.**

it not be nice if we could only cause the rectifier to give us some additional bumps of current which we could drop into those gaps in Fig. 1B, plugging them without any aid from a filter? In one moment we would be rid of the blown condenser, the unsteady voltage, the need for any "anti yooping" devices, the danger of a violent shock from a charge left in the filter after the set is turned off, and—this is important—we could key in the 110-volt line where keying is easy and where there is no key thump. On top of all this the rectifier will have less work to do for it will not be asked to stand the filter voltage on top of the transformer voltage.

### NOT AS BAD AS IT SOUNDS

There remains only a pair of difficulties. Will this require any very special knowledge or skill, or will it cost too much? The answer to the first question is "no". One can probably build such a system from a reading of the present description. As to the cost, that depends on local conditions; the present story relates to the largest sort of supply that any amateur will need and a little arithmatic will show that it costs less than one would pay for the usual sort of supply with all the usual sort of trouble thrown in. Later on several suggestions will be made as to smaller sets and changes in the present one.

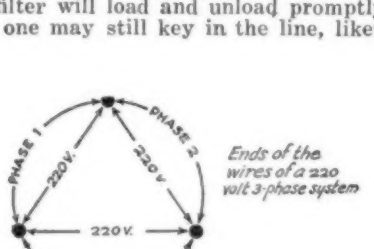
### CONCERNING 3-PHASE SUPPLY

This is not a class in electrical power transmission, therefore, we will talk just as little about the meaning and uses of 3-phase supply as we may. Suppose that the 220-volt 3-phase power has been run into the house and we have before us the ends of the wires as shown in Fig. 2. A voltmeter will show that we have 220 volts between any two of these wires.

The voltmeter will *not* show us another and very interesting thing—that the voltage "peaks" do not happen at the same moment on the three wires. What actually does happen is as shown in Fig. 3A. We do not care now why this is so, but it is. If we rectify each phase in the usual "full wave" manner we will have a set of outputs that will look like that of Fig 3B. If these outputs are all fed to the same load the voltage to that load will look like Fig. 3C. It is rather easy to see that we hardly need to bother with a filter here—the ripple that is left is no more than one likes to have for the sake of removing the monotony of pure d. c.

### THE DISTINCTIVE TONE

If d.c. is desired for any reason it is easy enough to get, a small condenser alone will smooth out the ripple without landing one in any of the usual difficulties. Being small the filter will load and unload promptly so that one may still key in the line, likewise



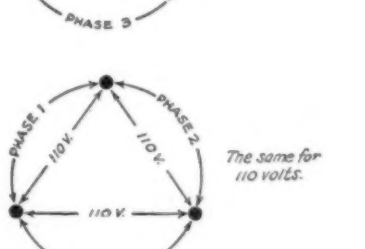




**FIG. 2. WHAT IS MEANT BY A 3-PHASE SUPPLY**

**If the load and line are balanced the voltage between any two wires is the same, though the voltage peaks of the cycle do not occur at the same instants.**

one can afford a condenser that will not blow up on the working voltage, especially as the working voltage is mostly d. c.

However, it is hardly desirable to use the smoothing condenser for some ripple

is rather pleasing to the ear of the receiving operator. Besides this one may by merely pulling switches on the various rectifier tubes adjust the ripple to secure (with 60-cycle supply) smooth tones of 360, 180, 120 or 60 cycles. The 360 will be a smooth note that is mostly d.c. The 180-cycle note will have about 70% of d. c. under it, while the 120- and the 60- cycle note will be the ordinary full-wave and half-wave "unfiltered r.a.c.". By closing 4 or 5 of the switches it is also possible to obtain 240 or 300 ripples per second but they will not be evenly spaced and the note is rather odd.

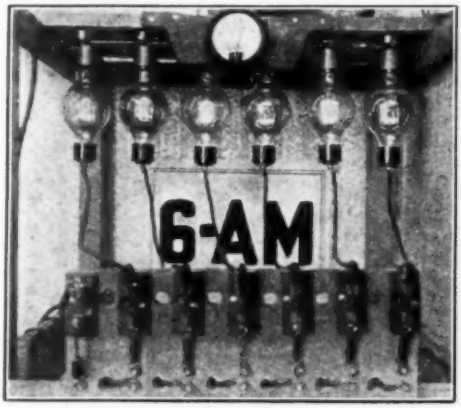
For 50-cycle supply such as is used at 6AM the corresponding pitches are 300, 150, 100 and 50 with the odd "notes" at 200 and 250.

### THE START

Many of you do not realize that in most cities, at least, it is comparatively easy to get 3-phase current wired into a home. In southern California all that is necessary is to make a deposit of $10 which is refunded after one year. The minimum meter-charge is $3 per month. Inquiries made of generating and distributing companies in other parts of the country have produced varying results but in general the attitude seems to be that if the 3-phase power is nearby they are willing to run it in at a moderate cost. Naturally, a 1 kilowatt load will hardly cause them to feel enthusiastic about setting a line of poles and putting in a line at a cost of several hundred dollars. Where that is the case one had better refer to some of the suggestions farther along in this story and then make out a list of costs on the various possible schemes, being sure to make one for the ordinary single-phase system which is usually more expensive than the owner realizes.

### THE 6AM INSTALLATION

The installation at 6AM supplies each of the 6 rectifier bulbs from a separate transformer. Of course, 3 transformers with center-tapped secondaries could have been used, as could a single 3-phase transformer with 3 center-tapped secondaries, one for each phase. The power rack therefore, looks rather more impressive than might be the case at other stations. When one considers that old power line transformers are just about the cheapest form of equipment that an amateur can buy, the economy of getting old line transformers and mounting them on a rack as shown is very evident. The bottom shelf of the power rack (see photos) has on it three one kilowatt power-line transformers with 220-volt and 6600-volt windings. These are transformers whose core losses had increased until the Edison company at Alhambra junked them. High core losses are of course not serious for the intermittent service of a radio transmitter, in fact the average amateur equipment is probably not very good in this regard. The insulation of such transformers is fine and they may be purchased for $7.50 each by anyone. The cases and oil were removed. There are of course 6 transformers in all, the other three being on the third shelf up. It frequently happens that the three phases do not deliver exactly the same voltage, or else that there is a difference in the transformers, so that the voltage from each is not the same. On the transformer shelves will be seen some coils that contain odd pieces of iron. These are chokes placed in series with the primaries of two of the transformers which deliver too high a voltage. (See Fig. 4.) Nails, bolts and other pieces of iron were placed in these coils until the output (current through rectifier tube) was the same for these as for the others. A hammerhead was used in one!




**THE RECTIFIER BANK, SIX OF THE "6EX RECTOBULBS"**
**The filament voltmeter is above the bulbs, the cutoff switches below.**

### THE RECTIFIER

Just as the ordinary "full wave" rectifier calls for one rectifier tube for each phase (considering the two halves of the center-tapped secondary as two opposed phases) so this set calls for one tube for each phase.

Our ordinary rectifiers use one tube for "half wave" or two tubes for "full wave" rectification. That is for a single phase supply. Naturally, when we have a 3-phase supply there will be needed 6 tubes for full wave rectification. We could use half wave rectification of course, which would only require 3 tubes, (and in the 6AM arrangement only 3 transformers) and would still give a very smooth output with a large proportion of d. c. in it—considerably larger than our ordinary systems.

The tubes used in the 6AM installation are the Rectobulbs manufactured by G. W. Lewis. The filaments draw 6 amperes each at 10 volts, which means that the filament transformer must supply 36 amperes at 10

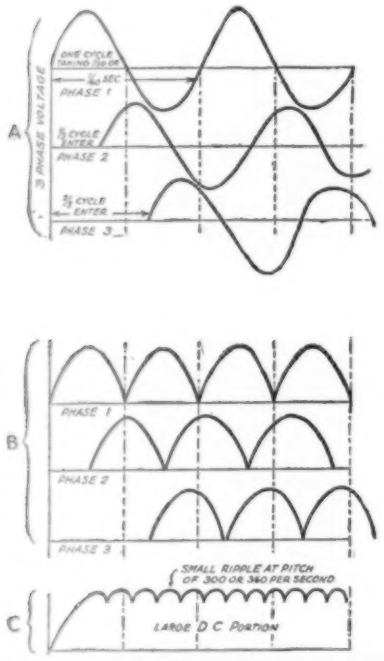



**FIG. 3. THE MANNER IN WHICH A 3-PHASE FULL-WAVE RECTIFIED PLATE SUPPLY OPERATES**

**This may also be called a 6-phase half-wave supply.**
**A—The three phases before rectification.**
**B—The three phases after rectification.**
**C—The three rectified phases combined for feeding to the tube.**

volts or 360 watts, besides which it must of course be insulated for the full plate voltage of 6600. Rather than wind a special highly insulated transformer a 3-kilowatt line transformer was used. It has two low-voltage windings of No. 10 wire and these are worked in parallel. 220 volts are applied to the high-voltage winding and 22 volts taken from the secondary, a suitable rheostat $R_2$ being used to reduce this to the desired 10 volts. That rheostat is shown at the bottom of the transmitting rack. It controls the filament of both the Rectobulbs and the oscillator tube to compensate for line voltage variations. Separate adjustments for each are provided by the iron-cored chokes $L_3$ and $L_4$. By referring to the way in which the Rectobulbs are hooked up it will be noted that one filament supply lead goes to the right end of one bus and the other supply lead goes to the left end of the other bus. In this way identical voltage to all tubes is assured.

When using a plate voltage of 6600 it is dangerous to key in the so-called center-tap as someone may forget at the wrong moment and touch the set when the voltage is on though the key is open. Keying is therefore handled by a Leach relay which breaks two of the three lineleads and therefore opens all phases. The extra contacts of the Leach relay are used to break the receiving aerial so that break-in can be used at any time.

The smoothness of the keying is assisted by the 600-ohm resistance R3 in the plate lead. This resistance consists of three 200-ohm potentiometers in series. Before proceeding to the necessary tests of the transformers it may be well to finish describing the station.

The gridleak resistance $R_4$ is a 5000-ohm Lynch type P resistor.

$R_5$ is a makeshift center-tap for the Rectobulb filaments. It is an 8-inch piece of the coiled wire from a burned out electric hot plate. The three limiting resistances $R_1$, $R_2$ and $R_3$ prevent sudden surges such as sometimes result from throwing an un-excited transformer on the line. They, therefore, help to smooth the keying but do not particularly affect the circuit otherwise as their resistance is only 2 ohms each.

Any chance of a serious arc thru a damaged rectifier or oscillator tube is avoided by the ¼-ampere fuses $F_1$ in series with each tube. In case the rectifier system should ever be out of order an airbreak switch has been provided in series with each tube and finally if it is desired to operate without any rectifier one may close an extra switch (7) and operate with "raw a. c.". This switch is also fused to protect the oscillator tube.

Radio frequency voltages are kept from the rectifier by means of the chokes and by-pass condensers shown in the diagram. This aided in clearing up the note. Chokes RF1 are made of 200 turns of No. 30 d.c.c. wire on a 1" tube, the turns being spaced with thread. The by-pass condenser consists of two UC 1015 RCA condensers in series, giving a capacity of .00025 μfds.

Radio frequency is kept from the line as far as possible by additional chokes. In the oscillator filament transformer primary are chokes $RFC_2$ which have 200 turns of No. 16 d.c.c. on a 1¼" tube. In the main line are chokes $RFC_1$ which are wound of 200 turns of No. 12 d.c.c. on a 1¼" core.

Each of these chokes has been of further aid in cleaning up the note and by preventing r.f. from getting back into the line, prevent the station from bothering neighboring BCLs. The transmitter is clickless as it is

keyed in the primary. Anyone 50-100 yards away is not bothered as far as we know.

### THE OSCILLATOR AND ANTENNA

The oscillator is a water-cooled tube, also made by Lewis of 6EX.

The waves regularly used at the station are 79, 39 and 21. The station can also be operated at 5 meters though the shift to that wave is not so prompt. At the top of the oscillator frame may be seen 4 cards that look like postals. These are charts, each bearing the information needed for setting to one of the waves named.

The antenna is a 1-wire horizontal approximately 62 feet long, split at the middle so that is becomes two 31 foot lengths. Where they meet at the middle they connect to a 2-wire r.f. line 60 feet long and spaced 4". The two National transmitting condensers C3 are tuned so that there is a node at the center of the coil $L_2$—the test being to see where no spark can be drawn by a pencil. To find out if the antenna and feeder are of the proper length one only needs to short across the two feeder wires at X, Figure 4. If the condensers still tune to the same place, retaining resonance, everything is right. If the shorting of the r.f. line at X does not give these results, change the length of the antenna. (Shunt the r.f. meter while making this test.)

Apparatus not appearing in the photos includes the receiver and the transmitting keys. The receiver is a copper shielded affair with a stage of r.f. made of and along the lines of the National-Browning-Drake sets but modified for short wave c.w. Without this receiver, European reception in the 40-meter band was rather scarce but the r.f. stage has materially improved matters so that signals from Europe have been received as high as 10 nights in a row. There has lately been added another shielded set with a stage of UX-222 r.f. that seems to be giving splendid results.

The keys are numerous. There are several hand keys, an Omnigraph for sending test signals, and an Electro bug, any one of which may be used to operate the Leach relay. The Electro Bug, which makes any number of dots evenly and automatically was won in the code sending contest at the A.R.R.L. convention in San Diego.

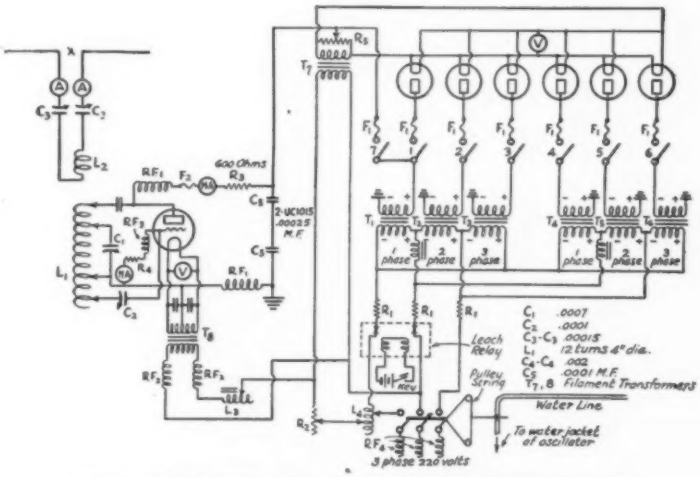



**FIG. 4. COMPLETE DIAGRAM OF TRANSMITTER AT 6AM**

**It is to be understood that the separate ground shown on the oscillator and on the plate supply secondaries are actually one ground bus. The water-supply for cooling the oscillator is mechanically interlocked with the 3-phase power-supply switch so that the power and water go on and off together. The constants not given here are explained in the text.**

**T1, T2, T3, T4, T5, T6—plate supply transformers 220-6600 volt.**

**T7, T8—Filament transformers.**

**L1 and L2 Tuned circuit inductances suited to wave in use. C1 Special high voltage condenser with spacing of 1 inch and maximum capacity of .0007 μfd.**

**The other variable condensers are all of National make with capacities as follows, C2 .0001 μfd., C3-C3 .00015 μfd each.**

**The plate stopping condenser is of mica as is the rectifier by-pass condenser C5-C5.**

**F1 and F2 are 3" lengths of ½-ampere fuse wire.**

### TRANSFORMER TESTS

Returning now to the plate supply we will take up some points that may easily be very puzzling.

The marking of the transformers as to polarity is usually not clear and it is best

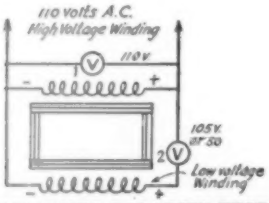



**FIG. 5. TRANSFORMER POLARITY TEST CIRCUIT**
**When making tests be sure to tag each transformer as a mistake is serious.**

to make tests to avoid considerable danger. The testing scheme is shown in Fig 5. Nothing is necessary but one meter able to measure in the neighborhood of 110 volts a.c. The diagram shows two meters but that simply means that the same meter is connected on in two ways. First connect the 110-volt line to the transformer as shown in Fig. 5. Measure the line voltage and then connect one side of the secondary winding to one side of the primary, thereby putting the two windings in series—either aiding or bucking. Now measure the voltage in position 1, which is simply a check on what you did before. Then measure at position 2. If the voltage is lower than it was in position 1 the two windings are bucking and the polarities are as shown. Otherwise reverse the connection of the secondary winding until these results are obtained.

*Caution—Before doing anything be absolutely certain you know which is the high voltage winding and be sure to connect the 110-volt line to the winding. If you get the wrong winding there will be some thousands of volts across the other winding and someone will be killed.*

If you are sure to connect the 110-volt line to the high-voltage (small wire) winding you will have a stepdown transformer and the voltmeter will simply read about 5 volts more or less in position 2 than it did in position 1—and neither 115 not 105 volts is dangerous.

### FURTHER TESTS

Having tested *and tagged* all the transformers as to polarity it is well to make some rough tests as to the goodness of the windings. For instance one may connect the low voltage winding of a transformer to the line through a large rheostat (carbon pile—salt-water—flatiron) and *with a long stick of dry wood* push the high voltage wires toward each other. It should be possible to draw a good hot arc.

Another test is to put the line into the high-voltage winding (just as in testing polarities) and measure the voltage of the low-voltage winding with a filament voltmeter. By switching around to the various taps one may find a combination such that all the transformers will (with the same line voltage) give the same secondary voltage. Use these taps later on in the set.

### ADJUSTING

After the transformers are tested, put into place and connected and the tubes all found to light properly, the switches are thrown in one at a time. If the output remains the same on any one of the switches then the resultant note will be even and smooth. Before trying this it may be necessary to tune up with all switches in and

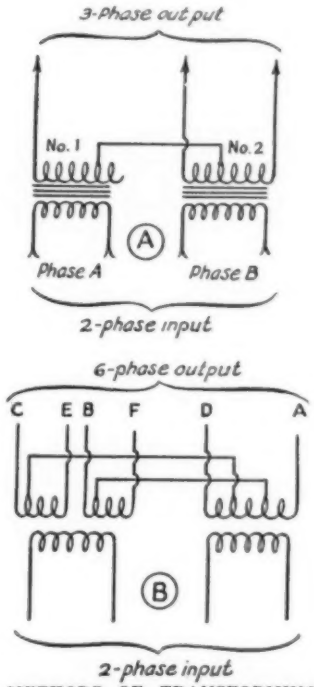



**FIG. 6. METHODS OF TRANSFORMING FROM 2-PHASE TO 3-PHASE AND 6-PHASE POWER**
**A. Scott connection from 2-phase to 3-phase.**
**B. Two-transformer method from 2-phase to 6-phase.**

the tone anything that it may be. Any irregularities may be corrected for with the devices that have been suggested, provided no transformer connections are wrong.

When properly adjusted the system gives a note that is entirely free of the annoying "creeping" that results when two tubes are worked back to back, and the system has none of the delays connected with an m.g., which generally spoils break-in altogether. The various notes can be secured by working the switches as mentioned before.

If our bands are reduced in size—as seems certain—a distinctive note, especially if steady, will be an even greater asset than at present and it will be especially convenient to be able to change it. Incidentally, even if two stations use this same system they need not sound alike at *any* time. For instance in Minneapolis the highest note will be 360, in Buffalo 150 and in Southern California 300. Inasmuch as the filter may be connected to any of the various combinations—and that filter may be of various sizes—the combinations are very numerous, while always retaining the advantages.

In the installation as it has been described various amateurs helped with suggestions and with their hands. Especially should be mentioned Messrs T. E. Nikirk and G. W. Lewis of 6KA and 6EX respectively. The various more or less theoretical points and information as to the attitude of power companies are largely from engineering literature and from the advice of Mr. Harry Thompson of the Hartford Electric Light Co.

### OBTAINING 3-PHASE SUPPLY

For those who desire to use a 3-phase supply but do not think it is convenient to have such power wired in there are several alternatives, all of them depending on converting some other form of power into 3-phase power.

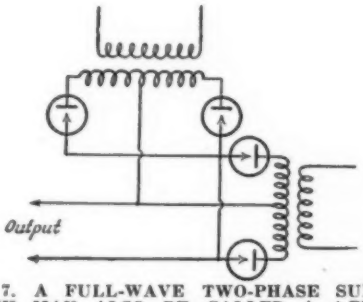



**FIG. 7. A FULL-WAVE TWO-PHASE SUPPLY WHICH MAY ALSO BE CALLED A 4-PHASE HALF-WAVE SUPPLY**
**To be used where 2-phase instead of 3-phase power is available.**

Of these methods the simplest by far is to start with two-phase power, converting it to three-phase by means of transformers alone. Probably the simplest way of doing this is the so-called "Scott connection" which employs two transformers with tapped secondaries. Referring to Figure 6A the transformers No. 2 is center-tapped and the lead from that tap goes to a tap on the secondary of transformer No. 1. The number of turns *used* on the secondary of No. 1 is 87/100 of the number of turns in the *whole* of the secondary of transformer No. 2. The dead end of the secondary of transformer No. 1 is of course useless. It will be noticed that the arrangement just described had but three output terminals and would therefore operate with 3 rectifier tubes and with somewhat more ripple than the 6-tube arrangement at 6AM. As a matter of fact the supply at 6AM is correctly referred to as a 6-phase half-wave supply, rather than a 3-phase full-wave. In order to obtain a 6-phase supply from a 2-phase source one would need to use another Scott-connected pair of transformers to supply the other three terminals, or else one might make the 2-to-3-phase transformermation at low

**THE FILTER BANK AND POWER PANEL**
**The rather impressive condenser bank is not often used. It is made of many low-voltage old-style condensers and has a total capacity (with present connections) of 1/3 μfd, which is ample to turn the note of this station into "pure d.c. ", showing the great ease of filtration. In the power panel we have from top to bottom, 3-k.w. transformer used for Kenotron filament supply, bank of rectifier tubes, one group of high voltage transformers, some chokes, second group of high-voltage transformers. The cup and the 9ZT card are Minneapolis souvenirs.**

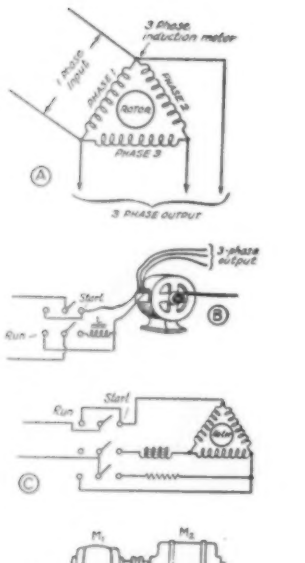



**FIG. 8. METHODS OF OBTAINING 3 PHASES FROM 1 PHASE WITH THE AID OF A 3-PHASE MOTOR**

**The same methods will work with a 2-phase motor in transforming from 1 to 2 phases. The motor has been shown as having a delta stator winding and a "squirrel cage" rotor but other types may be used.**

**A. General scheme. Single phase supply is fed to two of the stator terminals and when the motor is running 3 phase power may be taken from all 3 terminals. Phases 2 and 3 will have lower voltage and if the load is heavy this must be corrected for with resistance, chokes or transformer taps.**

**B. Simplest method of starting the motor with a cord wound around the shaft. The starting current is limited by L to a value not over twice the normal running current. L may be replaced by a resistance.**

**C. A split-phase method of starting. The method is not sound but has been used in the case of a 2 h. p. 3-phase motor with delta stator, both L and R being of such proportions to hold the starting current to about 2¼ times normal. The switch was in the starting position about 20 seconds.**

**D. A better method of starting. M1 is a motor whose speed is near that of the induction motor, but it should be of a sort not taking a large starting current. The connection may be by belt but there will be some difficulty with this and a coupling is to be preferred. One of the many possible connections is shown at D2. L may be a resistor or it, with SW2 may be omitted. The procedure is—close Sw1 to left, after a moment close it to the right, then close Sw2. The timing must be tried out.**

voltage and then go to the step-up transformers in one of the various fashions suggested previously.

As an alternative to this one may convert to 3-phase and step up at the same time with only two transformers, which must have the connections shown in Fig. 6B. This becomes complex and of doubtful advisability.

Before starting in on any of these arrangements it is best to gain a preliminary idea of the desired arrangement (current distribution etc.) by looking through some convenient reference book such as, for instance, the Standard Handbook. In the 4th edition the reference is Section 6, paragraphs 136 to 139, pages 406-408.

### THE USE OF 2-PHASE SUPPLY UNCONVERTED

As a matter of fact the whole business of conversion from 2-phase may be questioned. Unless one is greatly concerned with the desirability of a high-pitched tone without the use of any filter at all or any mechanical device to produce the tone it may be just as well to use the two-phase supply "as is", simply driving a "fullwave"rectifier system from each phase with the connections as shown in Fig. 7. This is of course a "two-phase full-wave" or a "4-phase half-wave" system. It is gifted with as high a percentage of d.c. as is "3-phase half-wave" (3 switches in) arrangement at 6AM and has a somewhat higher pitch. In both regards it aproaches the full 6-tube arrangement.

### 2 OR 3 PHASES FROM 1 PHASE

All of this may seem more interesting than useful since the usual house supply is *neither* 2 or 3 phase but ordinary single phase, either 2 or 3 wire, which is to say either 110 (or thereabouts) or else 110+110 =220.

It is possible to convert such supply into more phases by a combination or transformers, resistors, chokes and condensers but the arrangement is expensive and not flexible, that is to say it will not carry a load differing much from the design load. As soon as the load is changed the voltages and phases all get out of gee. This sort of thing is of no good in an amateur station.

A more practical arrangement would be to have either—A.—A single-phase motor driving a 2- or 3-phase generator. B.—A rotary phase converter made from an induction motor.

The first arrangement needs no comment. It seems to have almost all of the possible advantages and none of the defects of the high-voltage d.c. generators, in addition to which almost any sort of power can be taken from it for all sorts of purposes. However, the motor takes a large starting current unless we have starting equipment and we must pay for two comparatively large machines.

Sometimes it is simpler to use the rotary phase-converter.

### ROTARY PHASE CONVERTER

Any 2- or 3-phase induction motor can be used as a rotary phase-converter. Such use is not new and has been previously suggested in *QST* (April, 1924) by C. P. Sweeney for use in connection with a 3-phase mercury arc to provide a filter-less plate supply.

The scheme is briefly to feed single-phase current into two of the leads of the stator winding and to draw 2-phase or 3-phase output (depending on the construction of the motor) from all of the leads. The motor must be running when in use and since it will not start on one phase alone there must be some way of starting it. The diagrams suggest various ways of doing this without drawing enormous currents. The motor may be started in so simple a manner as by merely giving the shaft a twirl by hand or by a short rope wound around the shaft. There should be some sort of limiting resistance or choke in series to hold the current down until some speed has been gained, when the limiter may be shorted out.

If the motor is larger than ¼ h.p. this hand spinning becomes quite a chore and one longs for some way of starting electrically. The obvious way is to run the motor up to speed by means of another

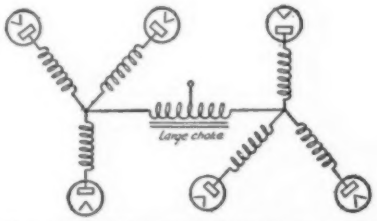



**FIG. 9. A FURTHER REFINEMENT OF THE 6-PHASE SUPPLY SCHEME USED AT WGY AND OTHER COMMERCIAL STATIONS**

**This scheme is adaptable to 6 separate transformers such as are used at 6AM. The choke has an iron core and its two halves are closely coupled; its purpose is to buck out the even harmonics. Such a system when well balanced may be used for speech transmission without any filter at all, though it is desirable to use one for high-quality work. The filaments are as usual center tapped, connected together and run to the "+" of the set; the center-tap of the choke is the "−" terminal.**

motor which is meant to run at the same speed (or within a reasonable distance thereof) and which does not demand an outrageous starting current. This may be a repulsion motor, repulsion-induction or universal. The only requirement is that it may be coupled or belted to the phase-converter, be able to run the converter up to such a speed that it will "take hold" and promptly go on up to full speed, after which the starting motor must be able to stand running continuously at the speed of the converter—though the starting motor is of course disconnected from the line.

RELATIVE ANTENNA CURRENTS IN FEED WIRES - 6AM

| RECTOBULBS | SUPPLY FREQ. | PHASES | WAVE | NOTE PITCH | ANTENNA AMPS. |
|---|---|---|---|---|---|
| Any one switch | 50 | Single | Half | 50 | 3.0 |
| No. 1 and No. 4 | 50 | Single | Full | 100 | 4.0 |
| No. 1, 2, and No. 3 | 50 | Three | Half | 150 | 4.6 |
| No. 1, 2, 3, 4, 5, and 6 | 50 | Three | Full | 300 | 5.5 |
| | | | | | |
| The above may all be filtered into D.C. or near D.C | | | | | |
| | | | | | |
| Raw A.C. No. 7 | 50 | Single | Half | 50 | 3.1 |
| A.C. may not be filtered and remains A.C. | | | | | |

**FIG. 10. CHART SHOWING PERFORMANCE OF THE RECTIFIER**

The diagrams of Fig. 8 also show how it is possible to get a start without either motor or handwork, but the usefullness of these methods depends largely on the size and the design of the induction motor used as a converter.

### BALANCING

A little thought will show that when we use the rotary phase converter scheme we draw 1 phase straight from the line while the other one or two are obtained by a species of transformer action. Naturally when a load is put on, the voltage of the "legitimate" phase will hold up better than that of the induced ones. This tends to make the system an unbalanced one so that the original phase will always have the higher voltage. This can be compensated for by exactly the methods used at 6AM, the setting being made for normal load. If the load is changed, re-adjustment will be necessary. Partly and fully automatic systems can be arranged to do this but are not worth while at small loads.

Naturally the balance is best if the machine is large as compared to the load. In any case the machine must be big as compared to the load, because of heating effects. The part of the winding connected directly to the line will draw more current than if it were only attending to its own 1/3 of the work in the usual manner, and a good general rule is to operate the machine at something like 1/3 its rating. Putting it differently a 1 h.p. motor (746 watts) ought to be able to supply something like 250 watts of 2- or 3-phase current without undue heating or unbalance. This is very general indeed and the design of the motor will change

*(Continued on Page 55)*

# A Single-Control Device

By Warren E. Danley*

THAT there is a popular demand for single control is generally recognized. Furthermore, from the standpoint of manufacturing costs, single control has an advantage over multiple control, notwithstanding the necessity of somewhat greater refinement in manufacturing processes. In practical operation with the variety of aerials installed by set owners, full efficiency has only been obtained when there has been some provision for an auxiliary adjustment of the tuning of the stage immediately connected with the aerial.

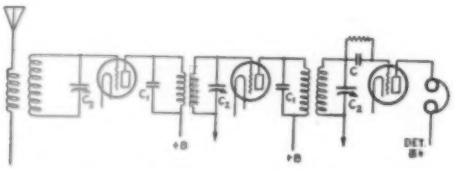


FIG. 1. SCHEMATIC DIAGRAM SHOWING THE IDEA APPLIED TO A SET WITH A TWO-STAGE R.F. AMPLIFIER

The condensers C, $C_1$ are the ones referred to in the text. Grid-returns, etc., have been omitted to simplify the diagram. In the actual set the tuning condensers $C_2$ $C_2$ $C_2$ would be connected mechanically.

In effect, this has constituted dual control.

I have developed a radio frequency amplification circuit which makes possible single control. In respect to both selectivity and amplification, the circuit seems slightly superior to the common transformer-coupled tuned radio frequency circuit.

An adjustable condenser $C_1$ (not variable in the customary sense) is shunted across the primary of each of the radio frequency transformers which follow the aerial stage, as shown in Fig. 1. When the set is connected to an aerial, these condensers are adjusted so that the natural frequency of these primary circuits is the same as the natural frequency of the aerial circuit. This is a simple adjustment, correctly made when maximum response is secured for any station, preferably a distant one of relatively low wavelength. With the correct adjustment, there are nearly identical coupled circuit effects in all the radio frequency stages, given coils and tuning condensers which are mechanical equivalents. Accordingly there is no need for an auxiliary control of the tuning of the aerial stage, for identical variations of the capacities in shunt with the secondaries of the several transformers will produce identical tuning effects in all stages.

*Consulting Statistician, 155

In an aerial circuit there is, of course, some inductance in addition to that of the primary winding of the first transformer. From the theory of coupling, it follows that, given transformers which are mechanical equivalents, that the coupling in the first stage is somewhat looser than that in the following stages. Therefore, theoretically, there should be some way of equalizing the several couplings. Practically, however, the couplings are commonly so loose that there is no necessity for coupling adjustment. In other words, given relatively loose coupling, the tuning of the individual circuits is much more important in determining the frequences to which the coupled circuits will resonate than is the exact degree of coupling.

The gain in selectivity suggested above is appreciable at the higher frequency settings of the tuning controls. This may possibly be explained as follows. In the common r.f. amplifier the coupling is not very great and the natural frequency of the primary is of such a high order that the coupled circuit effects are somewhat weak and the reactance curve of the secondary tends to become similar to the curve A of Fig. 2. This curve is simply the reactance curve of a series-tuned circuit and is taken from Fig. 26 of circular 74 of the

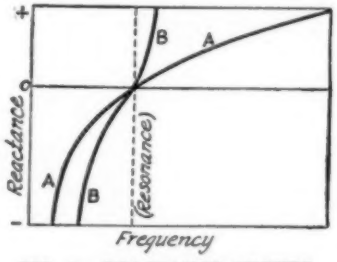



FIG. 2. REACTANCE CURVES

A. Series circuit such as R.F. secondary.
B. Combined series circuit and parallel circuit such as the tuned primary used here.

Bureau of Standards. When the primary is made resonant to a frequency materially nearer the secondary frequency there is a stronger coupled circuit effect similar to that shown in Fig. 2 B, which shows a reactance curve much sharper than that of Fig. 2 A. (Fig. 2 B is taken from Fig. 30 of the Bu. Stand. circular 74.)

A test of the circuit does not require a single control setup. In fact, a test run on a radio frequency amplifier built of matched individual condensers and matched coils will yield the best possible demonstra-

tion that the several stages can be made to tune exactly alike throughout the range of the receiver. In general, capacities substantially equal to the capacity of the aerial used are required for tuning the primaries. To compensate for stray and different tube capacities, it may be necessary to make some provision for shunting small fixed capacities across the secondary tuning condensers.

I have tried the circuit with aerials of widely different capacities and in no case were results disappointing. Of course, it was always necessary to avoid the use of any stabilizing method capable of an appreciable tuning effect.

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### 6 AM

*(Continued from Page 53)*

the performance as a phase converter widely.

The beauty of such an arrangement is of course that the motor, once started, is connected directly to the line without a moving contact anywhere in the system and therefore will not make the electrical uproar that comes from an ordinary m.g. Having no mechanical friction except at the bearings it will also make very little mechanical noise and can therefore be allowed to run most of the time, especially if it can be placed a short distance from the set.

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## Official Wavelength Stations

THE Official wavelength System furnishes a service coöperative with, but differing from, that of the Standard Frequency Stations 9XL and 1XM, which are also operated in accordance with plans made with the O.W.L.S. Committee. Contact with the O.W.L.S. is through Mr. D. C. Wallace, 6AM, who is also chairman of the committee. Mr. Wallace is continuing the practice of checking up all O.W.L.S. to make sure that they are really indicating their wavelength (or frequency) at the end of each transmission—and are doing so with proper accuracy; which is to say 2%. They do this in the course of regular operation and do not send calibration schedules as do the S.F. stations.

The list is as follows:

1AAC, 1AVW, 1AWW, 1BHW, 1BZQ, 1CCW, 1CK, 1KP, 1ZL, 1ZO, 2CLA, 2DS, 2MU, 2SZ, 2XI, 3APV, 3BE, 3XW, 4LK, 5AGN, 5AKN, 5EW, 5MN, 5OX, 5PH, 5SP, 5XBH, 5ZAV, 6AKW, 6AM, 6BB, 6BCP, 6BGM, 6BMW, 6BQB, 6CAE, 6CMQ, 6CVO, 6LJ, 6QL, 6SX, 6TI, 6TS, 6XAG, 6XAO, 6ZE, 6ZZH, 6ZV, 7AGI, 7BE, 7BU, 7GQ, 7NX, 7QK, 7XF, 7ZX, 8AA, 8APZ, 8BAU, 8BZT, 8EQ, 8GU, 8GZ, 8XC, 8ZG, 9AXQ, 9BCH, 9BGK, 9BMR, 9CPM, 9CXU, 9DXN, 9EFO, 9EGU, 9ELB, 9FF, 9IG, nc1AE, nc2BE, nc3CO, nc3NI, nc3FC, nc4BT, nc9AL, eg2OD, eg2SE, Ireland 5NJ, oa2CM and oz2AC. Crystal Controlled O.W.L.S.; NKF, 1AXA, 2BO, 2BRB, 2EF, 2WC, 4BY, 4XE, 6AOI, 6DLL, 8CMM, 8DAJ, 9AUG, 9BVH, 9UZ-NRRL, 9ZA, eg2NM, eg5LF and oa5BG. Standard Frequency Stations: 1XM and 9XL.

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## The South Dakota Convention

ALTHOUGH the thermometer at Sioux Falls on the morning of December 28th registered 14 degrees below zero, when the convention was called to order by Director Jansky it did not freeze the enthusiasm of the assembled delegates who had come from Minnesota, Nebraska, North and South Dakota and Iowa.

After the proper introductions of traffic officials, Nick Jensen, the old time amateur and friend of Hams, took charge and Oh, Boy! what a good time we all had until we drank the last cup of Modulated Java.

The committee had secured a room on the fifth floor large enough to take care of a dozen cots and installed a complete ham station to enable the "Boiled Owls" to work to their heart's content—which they did as well as register some pretty good "dx" as there were some good prizes to be worked for.

There were no very highly technical talks but good, sensible information was given by 9DB, Beck, the SCM, on transmitter tuning with the equipment right before your eyes; and by Dwight Pasek, 9DGR, on "Mercury Arc Rectification". And with plenty of discussion, a whole lot of interesting "dope" was given, which caused this old reporter to think that with such talent at work there should be no worry about overcoming such difficulties as we may have when we have to adjust ourselves to the new regulations when they are put into force.

Johnny Berg, the Route Manager, was the winner of the largest number of contests and if he is as efficient with planning schedules for the fellows his section should lead.

A couple of the most interesting events of the convention were the trips to the State Penitentiary under the leadership of Nick Jensen, who by the way is deputy chief marshall, and to the Morrell packing plant.

Director Jansky in his usual good way

*(Continued on Page 88)*

# I.A.R.U. NEWS

DURING October and November most of our leading operators were fully occupied with tests on the five-meter band. Everybody was prepared for the international tests that were run and we are sorry to report that nothing was heard from the other side nor from the locals excepting the usual lot of harmonics.

"New contacts have been made between Belgium and Hawaii by both eb4XS and eb4AU. Several other good distances were bridged by 4WW, 4ZZ 4CO and V8. The following stations were heard at Bellevue, Tasmania: 4AA, 4AC, 4AR, 4AU, 4AX, 4BC, 4CB, 4CK, 4CO, 4FT, 4BK, 4RS, 4OC, 4VU, 4XX, 4WW, 4ZZ, N33 and V33.

"General conditions during the last fortnight were very bad on the 20-, 32- and 40-meter bands. Practically no contacts could be made. Reports from the short-wave station at Brussels, eb82, confirmed this. This station operates on 16.25, 25 and 38.5 meters putting something in the neighborhood of ten kilowatts into a Zeppelin antenna."

*-Paul de Neck, President, Reseau Belge.*

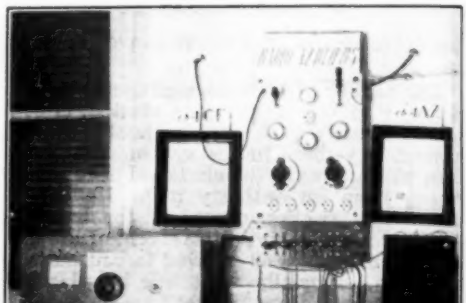
We are showing herewith a view of the station of R. P. Verreux located at 16 rue de Rome in Verviers. This is eb4AZ and also the broadcast station, "Radio Verviers". eb4AZ works on 45 meters with a pair of Metal or Fotos 20-watt tubes in a Mesny push-pull oscillating circuit. The plate voltage which is obtained from storage batteries is 600. The antenna is a 50-foot single wire and is operated against ground, no counterpoise being used. The receiver is the popular kind employing basket-wound inductances and regeneration is controlled by means of a variable condenser.

The broadcast transmitter works on 215 meters. Grid modulation is used.

### FRANCE

"Since October the amateurs in France have been on the air consistently. Every morning, ef8FD has been in contact with oz4AE at 0700 G.C.T. and has also made contact with af1B at Saigon, French Indo-China three times each week.

"In making some low power tests, 8FD succeded in working oz4AE when using an input to the plate of but 0.64 watts. This is equivalent to approximately 29,800 km. (18,360 miles) per watt. Communication was established before two witnesses who are members of the Reseau des Emetteurs Francais.



**eb4AZ-RADIO VERVIERS**

**The broadcast transmitter is on the left and the s-w transmitter is mounted on the wall at the right. The receiver is on the table between the two transmitters.**

"Signals on the 20-meter band from stations in the U.S.A. are coming in perfectly during the afternoons but lose their strength along about 2000 G.C.T. On the contrary, the 40-meter band is good in the morning and at 0930 G.C.T. the fifth and ninth and on rare occasions the sixth district stations are heard quite well. A contact was made between ef8FD and nu6AM when the power input to the transmitter at 8FD was only ten watts.

"Station 8JF on Nov. 9th, made a first contact with fb8HL located in Tananarivo, Madagascar. Following this, both 8CL and

*(Continued on Page 72)*

# Calls Heard

**oa-3WM, W. J. M. McAuley, "Mia Mia," Union St., Brunswick, Vic., Australia.**

ac-8em af-8fok af-8hva ai-2kt ai-2kw aj-1gs aj-1sh aj-1sk aj-4zz eb-4ac eb-4ww eb-4zz ec-earl ef-8cp ef-8eo ef-8ix ef-8jf ef-8ju ef-8nn ef-8fd eg-2od eg-5ku eh-9oc ei-1uu ei-1no ei-1er ek-4yo ek-4dba en-0ja xep-1ma nr-cto nj-2pz oc-8xz od-pki oo-dgk op-1hr fo-a4f fo-a5x.

**oa-4PM, Russell F. Roberts, West End, Brisbane, Queensland, Australia.**
(Heard during October)

2sz 3kh 4acm 5hep 5mea 5zav 6dmt 6bkh 6dpa 6clj 6dma 6dlr 6cex 6dog 6ewj 6bws 6amn 6aj 6akw 6dkx 6hj 6dfw 6lfq 6ap 6dey 6app 6ajm 6alk 6clj 6uxq 6dlk 6dfw 6ckj 6czr 6clj 6eww 6hlk 6ddt 6dlr 6dm 6dkv 6dey 6dju 7cs 8ceo 9jh 9cei aj-4zz aj-2by aj-2fx aj-1sk aj-1am ac-2ff ac-8rj ac-8to am-1ab ai-2kt od-1pd op-1cj op-1rc oo-bam oc-8xz.

**oa-5CM, Reg. M. Anthony, 3 High St., Unley Park, South Australia.**
(Heard during October, 1927)

1bms 1bux 1cjc 1cmp 1cmx 2atq 2crb 2cuq 2gp 2tp 3aih 3ckl 3lw 3pr 3oq 4fu 4ob 4rp 4rn 4sb 4si 5aav 5acl 5ajr 5amk 5avf 5aqe 5ba 5kc 5la 5nw 5ql 5rg 5ah 5wz 6ann 6app 6avj 6bdl 6bfr 6bjv 6bkh 6brw 6bsb 6buc 6cnk 6dbc 6dey 6dlr 6dor 6dqq 6dmd 6eb 6fh 6ud 7add 7adf 7lz 8ajn 8axa 8bau 8ccs 8ccw 8csu 8djv 9ara 9bil 9bw 9ck 9cn 9cwq 9cyp 9dcw 9dku 9dpw 9dr 9eev 9ef 9efw 9ekf 9ely 9kc 9xi ac-1ax ac-8hb ac-2ff ac-8rj ac-8to ai-2kt ai-2kw ai-2kx aj-1aw aj-1gs aj-2bk aj-4zz am-1ab ef-8eo ef-8jf ef-8zb eg-2az ei-1no eu-1ora fo-a3e fo-a3u fo-a4f fo-a4v fo-a4x fo-a8n fo-a8p fo-a9n fo-a9m fo-a3z fo-1srb fo-7sra op-1ad op-1at op-1bd op-1cw op-1ma op-4aa op-7il.

**oa-7CH, C. Harrisson, Rokeby Rd., Bellerive, Tasmania.**
(20 meters)

1aep 1asu 1akz 1caw 1sz 2ahm 2bg 2dr 2ox 2tp 3bev 3rb 4ft 4jr 5nec 5aqu 5uk 6bb 6bih 6bux 6clt 6dch 6dgq 6dfe 8ahc 8avd 8cil 8csr 9ara 9bjj 9bvh 9cv 9dnu 9ef 9kv eb-4au eb-4ww ed-7cz eg-2nh eg-2it ef-8yor nr-cto or3 cr1o oh-6akpt oh-6bdl.

(30 meters)

eb-4ac eb-4bc eb-4bk eb-4co eb-4ft eb-4oc eb-4xx eb-4vu eb-n33 eb-v33 ec-ar54 ef-8cr ef-8ee ef-8er ef-8fd ef-8ft ef-8fy ef-8kg ef-8kk ef-8ku ef-8ln ef-8nn ef-8xo ef-8yy ef-8abc ef-8aro ef-8est ef-8oeo ef-8tis ef-8raf ef-8rlt ef-8vvd ef-8xix eg-2bi eg-2bz eg-2gf eg-2oq eg-2qb eg-2jb eg-5kh eg-5ku eg-5ls eg-5mq eg-5uy eg-6rw ei-1au ei-1cr ei-1dl ei-1dm ei-1dy ei-1uu ek-4abv ek-4dbs ek-4uu ek-4ya ek-4ynb ek-4yo el-1ala el-1nlw en-0cy en-0fp en-0ja en-0ze ep-1aa ep-1aj ep-1bl ep-3gb er-san fe-egez fi-1cw fk-4ms fo-a4c fo-3er ac-vps ac-1ax ac-2ck ac-2ff ac-8rj ac-2bk ai-2kt ai-2kw ai-2kx aj-1sm aj-1sk aj-4zz am-1ab am-3ab aq-1lm nc-1ac nc-1ax nc-3nj nc-1co nm-8a nm-1k nn-m3y nn-1nic nq-8kp nq-2ac nr-2fg ns-1fmh sa-hgl sa-cb8 sc-3ag od-4as x-5ma xen-ocp xep-1ma nidk oie 2bn gkt wxr nwq vpx nixb kdo.

**oz-2BJ, 269 Taranaki St., Wellington, N. Z.**
(Heard during October)

2are 2afr 2ag 2amh 2ev 3bqz 3cdg 4km 4qb 4rm 4uo 5acl 5aq 5ayl 5co 5kc 5ok 5rg 6aak 6ahn 6am 6aqm 6avj 6baj 6bb 6bh 6bhz 6bjh 6bjq 6bkh 6bpm 6cgr 6cmz 6cqm 6cqp 6cto 6cua 6cwj 6cww 6czz 6dfe 6dfu 6dhq 6dkv 6dxx 6dlj 6dnh 6dog 6dor 6ec 6ew 6gw 6hj 6ix 6la 6rn 6ty 6ud 6wh 7aa 7acf 7add 7bb 7ek 7ou 7tz 7xf 8avk 8avp 8cfv 8ckc 8ey 9auu 9bmm 9bpl 9bre 9bzi 9cfd 9cpq 9crd 9dku 9dr 9eev 9ef 9efw 9ely 9ff 9nr 9oj 9xi eb-4ww eb-4zz ef-8cp ef-8nn ef-8xo nr-cto oc-8xz oh-6ahl oh-6ajl oh-6avl oh-6alm oh-6boe oh-6buc oh-6ch oh-6dey oh-6dju oh-6dlr oh-6dqq oh-6wu oo-6am sb-1ah sb-1ib sc-3ac su-2uk aqe arcx ardi bam fy fyb kzet 1pl.

**Robert Kreisinger, Maracaibo, Venezuela.**

1ads 1bkp 1ckp 1de 1ga 1pa 1xv 2abe 2ag 2bvh 2exl 2di 2gk 2hv 2ol 2ov 2qu 2tp 2uo 2vs 2xam 3ag 3ahp 3ais 3auv 3ckl 4nao 4ac 4br 4cf 4cu 4ge 4jd 4kf 4tv 5adg 5amk 5axs 5ns 5rg 5uk 5we 5zav 6am 6cnj 6dgx 6xi 8alu 8ane 8aro 8as 8axg 8axz 8bau 8bhz 8bni 8bqr 8brc 8brf 8cau 8cc 8ced 8cfr 8coj 8dgl 8dlv 8dqb 8fb 9ara 9axu 9axx 9bhz 9ck 9cpr 9czh 9dcb 9dck 9drw 9dzb 9eaj 9ely 9ra eg-6nf agb anf fy nrrg pkh poa sgl xc51.

**Cpl. Henry P. Karr, Hq. Btry. 2nd F. A. Bn., Gatun, C. Z.**
(20 meters)

1acm 1ajm 1awe 1cra 1bhm 1sz 1xz 2ank 2anm 2arn 2aol 2avz 2bac 2beh 2et 2fp 2gq 2jn 2tp 2va 2xam 3aic 3ani 3bsd 3cw 3jm 3ku 3ra 3tn 4abc 4dv 4qb 5akp 5av 5nb 5nj 5lf 6aaz 6bzc 7aae 8ams 8atv 8avb 8bhz 8bl 8bqf 8dbm 8dnn 8dpo 8re 8ut 9aji 9amb 9apl 9arb 9as 9asc 9bgq 9bnd 9efd 9cis 9civ 9cki 9ckq 9cmo 9cmv 9cqm 9dd 9dij 9drd 9eaj 9eap 9ecz 9efh 9egq 9cht 9emn 9epf 9pf 9rf 9ux ef-8no ef-8uz nc-1ar nc-3cj nc-3cm nc-4ey nm-1l wgt.

(40 meters)

1age 1amj 1ara 1awe 1bda 1blf 1bux 1cd 1ckw 1dm 1ic 1to 1vw 2aih 2ass 2aqo 2avw 2axx 2baa 2baz 2bb 2bew 2ce 2cej 2fj 2jp 2ju 2mu 2rp 2rs 2pv 2xd 3adi 3afx 3afu 3aih 3aks 3bsd 3ex 3kt 3qe 3rq 3tn 4ada 4an 4cu 4cv 4ep 4fe 4ff 4ha 4lk 4uo 4vf 5afx 5ai 5ain 5ank 5ant 5aqf 5gd 5hp 5ja 5kc 5kd 5la 5ln 5lo 5nd 5no 5uc 5yb 6aak 6aat 6am 6bgp 6cty 6di 6dr 6eb 6id 6ud 7abk 7afu 7aw 7ek 7if 8ajt 8ccq 8cym 8dbd 8dg 8gq 8jq 8rj 8vd 8vx 9awj 9bgq 9bho 9blf 9bpx 9bqc 9bul 9ccm 9crd 9crj 9cup 9deu 9dfj 9dkg 9dlq 9drw 9dxg 9dxp 9dzj 9ek 9ekw 9emj 9eow 9es 9oq 9ww 9xi xen-0sq nc-2be nc-3bo nq-2jt nq-2pt nq-7cx sb-1ar sb-1ao anf ir1.

**fo-GEDQ, Simonstown, South Africa.**
(Heard since Oct. 15)

1amd 1lu 1bux 1bgq 1aof 1xi 1aq 1cmx 1ckp 1ah 1cio 1wl 1cnz 1ic 2ayj 2cxl 2cdl 2bad 2cu 2tp 2am 2abe 2ag 2rs 2ie 2nm 2pf 2cuz 2avw 2bbx 3bnu 4yd 4cu 4rn 4lk 4kw 4aar 5ahp 5yb 5nf 6dly 6hm 6aak 6ju 6bjx 6dos 6dpu 8cc 8ed 8ckc 8dnf 8bwr 8axz 8bhz 9akt 9aok 9cmv 9dpw 9dcg 9cjw 9cpd 9bgk 9aeb 9dkc 9rf 9ek 9dax 9xi 9ejo.

**2AWU. (Heard enroute London to New York—over 2000 miles).**

1acu 1avj 1axx 1bux 1bvl 1ic 1xf 2acd 2afv 2alu 2cuq 2cxl 2cty 2cx 2dh 2md 2jc 2tp 3agf 3aib 3bnu 3ckj 3ag 3dh 3di 3kj 3kt 3pt 3lu 3qe 3qw 3sj 3uk 4ao 4by 4cu 4ob 4uo 4zx 8adm 8agy 8bin 8brc 8bhz 8bjx 8cau 8xe nc-9cx.

**3AG, Willard Hunton, Falls Church, Va.**
(Heard during Sept., Oct. and Nov.)

6aak 6abg 6ano 6agr 6apd 6axp 6bam 6bgb 6bpm 6buh 6bva 6bvs 6bxu 6cae 6cco 6ccz 6cdl 6cet 6czo 6dfv 6dhj 6dpo 6dre 6dmq 6es 6sm 7aat 7abb 7aiq 7fe 7ok nc-4bp nc-4cm nc-4cu nc-4gi nc-4hh nc-5ef ea-bu ea-cl ea-cm ea-fo ea-gp ea-jz eb-4ai eb-4ar eb-4au eb-4bv eb-4cb eb-4co eb-4di eb-4tm eb-4ww

*(Continued on Page 82)*

# Correspondence

**The Publishers of QST assume no responsibility for statements made herein by correspondents.**

## Some Amatuer Reactions on the International Radiotelegraph Conference

Just a word to these birds who are yowling about the decisions of the convention. We ought to be well satisfied with the concessions granted us in the face of what looked like the doom of amateur radio! These fellows don't realize what was happening up there at Wasnington—three or four representatives bucking the adverse attitudes of forty-five or fifty other representatives all intent on putting us in cold storage. I consider that we were exceptionally lucky to have as much territory given us as we did. One little tip: 80 meters isn't a bad wave at all for international work and just as good DX was done there as is being done on 40, with the added advantage that it is not as freaky at night as 40 has been lately. If you don't believe it, just dig up *QST* of about two years back and take a squint at the calls heard and the international section. Now, fellers, let's be sports, because what's done can't be helped and maybe these same adverse conditions will inject a little new life into the game—and Lord knows we need it. We are getting into the kind of rut that you read about in the magazine advertisements!

—J. M. Eubanks, nu4SI.

Congratulations, Fellows, on your eternal plugging to make us a better outfit. The fruits of your work are coming in, as shown by our placement into the International Conference papers.

—Victor H. Schleuder, 9BKX.

We would like a letter from Headquarters stating just why this "give up the ship" attitude before the treaty has been ratified by our government. If this government truly believes that the American amateur is really an asset, then why this attitude of generosity at the expense of her own assets? . . . Must we stand for the dictates of England and some of the other war-mad countries who would force this treaty upon the world? . . . Let's fight. We want action and not supine acceptance of this state of affairs. . .

—N. C. Hugus, 8CVS.

While probably the best thing to do is to make the best of the present amateur situation, I am convinced that the American radio amateur has been most unfairly and unjustly dealt with. . . We are told that our American delegation was back of us. Then why did they yield to the rest? Since when has it become necessary for the United States of America to accept the dictates of a crowd of foreigners who are fifty years behind the times in most respects because of their petty jealousies and perpetual warfare? If they balked at our Delegation's proposed amateur bands it was no more than happened at the naval conference last summer—and did Uncle Sam compromise his interests at that time? My recollection is that John Bull was advised that his proposals were unacceptable and we came home to run our own business in our own way. The idea of such foreign dictation . . . is simply too much to swallow.

—Ross Moorhead, nu8ARO.

Just a few words of appreciation in these dark days for amateur radio. I, for one, sense a little of the strenuous effort you must have put forth, and I'm sure we are, to a man, with you to the last ditch. Here's hoping the "narrow" is wide enough to exist on, but it looks dark.

—D. I. Gue, nc4FF.

. . . What I think of England would not be good news over there.

—F. J. Hinds, 9APY.

Please renew my membership for 1928. I also want to thank your organization for their work done at the Washington Conference. We amateurs appreciate this very much.

—Wells Chapin, 9DUD.

Congratulations on your noble efforts and success on behalf of A.R.R.L. Vy FB, OM. Everyone down here is very disgusted that Canada let you down so badly.

—A. G. Brewer, nc2BR.

It is with some misgivings and no little anger that I read of the proceedings of the international conference. It seems the amateur is looked on as a necessary evil. I believe the countries that are so opposed to the existence of the amateur are just a little jealous of the progress that has been made along that line. If those countries would allow their younger citizens to

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# "Performing Splendidly" At WNP

A. R. R. L. Radiogram from radio operator McMillan Expedition

THE AMERICAN RADIO RELAY LEAGUE
HEADQUARTERS HARTFORD CONN. U S A

RADIOGRAM

CITY OF ORIGIN | STATION OF ORIGIN: WNP | NUMBER: 6 | DATE: Jan. 2 | CHECK

THIS MESSAGE WAS RECEIVED AT 1820
AMATEUR RADIO STATION
OWNER Clark C. Robison
STREET ADDRESS 1711 Park St.
CITY AND STATE Hartford, Conn.

TO The Vibroplex Co.
825 Broadway
New York City

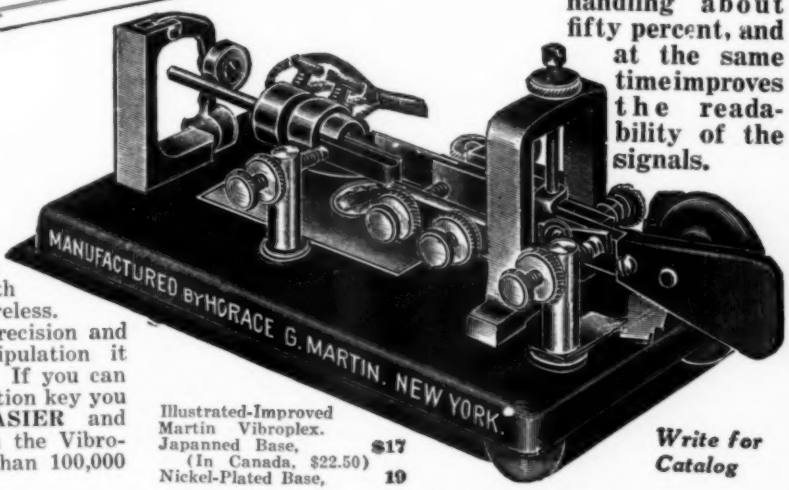
RADIO MODEL VIBROPLEX PERFORMING SPLENDIDLY AT WNP. IT KEYS OUR QUARTER KW. TUBE WITHOUT RELAY. NO OTHER KEY HAS BEEN USED FOR SIX MONTHS' BEST WISHES FOR A PROSPEROUS NEW YEAR
CLIFF HIMOE OF WNP

DATE | TIME | OPERATOR
LOCATED AT: Anatalak Bay, Labrador — Jan. 2, 1928 — 8a.m. rcd
Rec'd — FROM STATION: WNP
Sent — TO STATION:
PLEASE READ OTHER SIDE—IMPORTANT

"Radio Model Vibroplex performing splendidly at WNP." That is what it was built to do.

Himoe knew this—that's why he selected the Vibroplex as part of his equipment on the Bowdoin for the McMillan Expedition.

Himoe has been using the Vibroplex five years. He tells us it speeds up traffic handling about fifty percent, and at the same time improves the readability of the signals.




The Vibroplex is used for both wire and wireless. For clarity, precision and ease of manipulation it has no equal. If you can use the regulation key you can send **EASIER** and **BETTER** with the Vibroplex. More than 100,000 users.

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Japanned Base, **$17**
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BEFORE you think of another set, think what these new AmerTran products will do for the one you have. The ABC Hi-Power Box will deliver smooth power to plate and filament from the light socket, supplying sufficient voltage and current for push-pull 210 tubes and all other AC tubes required in a modern receiver. There is no fussing—no weak reception due to run-down batteries. This complete unit contains AmerTran-designed equipment, with a power transformer having separate windings to provide AC filament current to power tubes, the 281 rectifying tube, heater current for three or four UY-227 AC tubes, and current for four or five UX-226 raw AC tubes.

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experiment along radio lines, they would not be so far behind the good old U. S. A.
—A. G. Adams, Miller, Mo.

I want to congratulate the American Radio Relay League, its officers and employees, upon its splendid and, doubtless, heroic work in retaining the amateur wave bands for the amateurs of the world at the International Radiotelegraph Convention. I consider the action taken as a signal victory for amateur radio, and one of the outstanding accomplishments of the League. It again proves the necessity for the League, and I am personally grateful for the League and the men who administer its affair. They have done a noble work, and I am confident they were a handful against large odds. It is plain they presented our case in such a way as to convince the delegates that amateur radio is worthwhile and a potent factor in the protection of government.

—Bradford Hearn, 5ANC.

I sure do know this: that if it wasn't for the A.R.R.L., we amateurs would be a thing of the past by this time.
—P. T. Montgomery, Sandy Lake, Pa.

. . . I can appreciate the position you had, the selfish motives of the other delegates, the ignorance, their lack of an amateur problem and therefore their intolerance, their sinister attitude towards the United States. I have traveled this world enough to realize that the rest of the world doesn't love us, to know that they will not concede anything, not because it would help them necessarily by this non-admittance, but simply because of their inherent greed. But what better can we expect from a world whose intrigue has been ages old, whose motto is "Prevent others whether or not it would gain them, but simply because it is not gaining us"?
—W. E. Schweitzer, 9AAW.

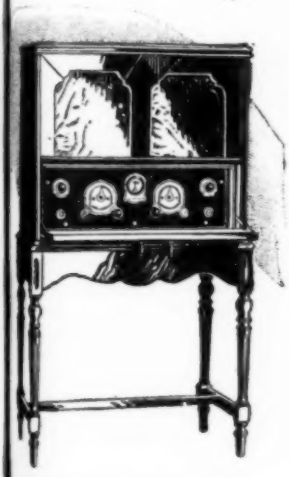
. . . Things turned out not so worse.
—Ehret, 5APG

Your editorial, *QST*. Twenty thousand American amateurs behind you. We will not accept a cut in any band without a fight. United States is big enough to run our own affairs. Positively will not be governed by local BCLs, much less by foreign QRM.
—M. O. Davis, 9CDE.

Congrats on the fine work done by you fellows at the Washington Radio Conference. Personally I expected we would lose all our waves between 12 and 75 meters.
—Chas. J. Heiser, 8DME.

. . . I really think that it will be a dirty trick if the 40-meter band is taken, because it was the A.R.R.L. and amateurs that made short waves what they are today.
—D. B. Lamb, S.C.M. Arizona.

*"Give me a place to stand and I will move the world," said Archimedes, first to realize the mighty power of the lever.*



No. 524 Stromberg-Carlson A.C. Receiver. Operates direct from house lighting circuit. Jack in panel for magnetic phonograph pick-up.

Price, with audio-power unit and 8 R.C.A. tubes—but not including Cone Speaker:

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| East of Rockies . . . | $425.00 |
| Rockies and West . . | 455.00 |
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# POWER

PURE, unfaltering tone in Radio demands a great reserve and flexibility of power, to vibrate the diaphragm of your reproducer in perfect unison with the ever-changing speed of the sound vibrations.

Slowly, s-l-o-w-l-y, the diaphragm is pulled back and forth in the deeper bass, then changing instantly to the tempo of unchained lightning in the higher registers. Whatever the demand, there is instant response in the reproducer attached to the Stromberg-Carlson Receiver.

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A variable grid leak that assures the ideal grid leak value. Enables operator to get best possible results with any tube.

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MILWAUKEE, WISCONSIN

. . . I don't see where we were so badly "laced". They narrowed our bands a trifle but that will force some of the amateurs into other bands besides 40—maybe that is a good thing at that. As you say in last *QST*, it takes difficulties to make us boys work.

—C. B. Diehl, 9BYG.

Am very glad to see that the amateurs still are holding their bands. Great work on the part of the A.R.R.L. officials.

—J. A. Gjelhaug, nu9ZC.

. . . The new allocations mean that the League will have to come to the rescue with some sort of plan. It will be bad enough to have the bands cut to one third their former size but how about the foreigners? . . . Looks to me like a polite and diplomatic way of gradually shelving the amateur by making him interfere with himself until he gets disgusted and quits.

—Frederick Westervelt, 8VE.

. . . Why do the (bad word deleted) want to decrease our bands? (Exclamation deleted) there's plenty of room on each side of our bands. Why in (censored) do they want to QRT us? Oh (expurgated) but it makes me sore. If we have to give up the waves, make the (more deletions) promise never to bother us again.

—E. L. Maneval, 8EU.

You are to be congratulated for holding as much as you did. Personally, I think we are sitting pretty. If you will fish around in the 40-meter band I think you will agree with me that approximately 70 to 75% of the amateurs are operating between 37.5 and about 39.8 meters. The rest of the band is used very sparingly, which is contrary to the condition which existed when we first got that band. Right now most of them are crowded at the lower end simply because when they answer a call the practice is to start at the lower end and tune up.

—F. H. Schnell, 9UZ.

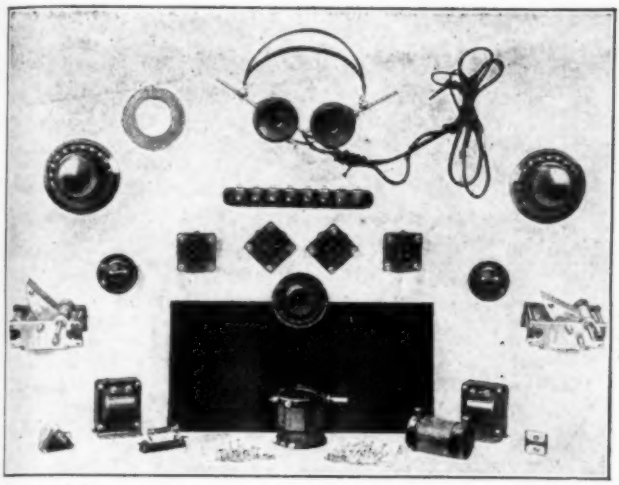
No utilitarian or government end can be served by curtailment of present amateur bands. Am convinced this move is British-inspired and most vindictive. As a member I am with you to maintain our position, heart and soul. As a citizen with powerful influence I will back you with bayonets and guarantee you the political death of all who oppose us. They owe me some allegiance—now they shall pay.

—Goodyear Pitts, Portland, Ore.

The Indianapolis A.R.R.L. members want to express their appreciation for good work done by A.R.R.L. officers at Washington Conference. Please transmit this to the proper parties.

D. J. Angus, 9CYQ.

# LEARN RADIO and find



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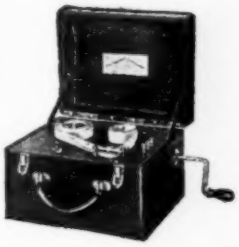

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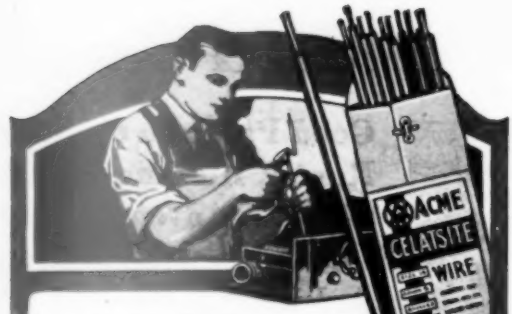


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### Flexible Celatsite Wire

**For Sub-Panel Wiring**

A cable of fine, tinned copper wires with non-inflammable Celatsite insulation. Ideal for sub-panel or point-to-point wiring. Strips easily, solders readily. Nine beautiful colors; ***sold only in 25 ft. coils, in cartons colored to match contents.***

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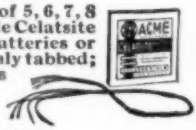

A rayon-covered cable of 5, 6, 7, 8 or 9 vari-colored Flexible Celatsite wires for connecting batteries or eliminator to set. Plainly tabbed; easy to connect. Gives set an orderly appearance.

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**ACME WIRE**

**MAKES BETTER RADIO**


Congratulations on the victory of the International Radio Conference. I realize the difficulties which you have faced at Washington, and I want you to know that I appreciate your efforts in my behalf, as one of the gang. I think we suffered some serious losses in the 40-meter band, and for a while it may be difficult to adjust ourselves to the new conditions, but the gain you made for us in the 10-meter band is splendid, and better yet is the retention of the whole 80-meter band.

—Louis R. Huber, ex-SCM Iowa.

I wish to extend to you on behalf of the Quebec Division our appreciation of your wonderful success at the International Radio Conference. Although we were unable to assist you in your work, we were with you during that very trying period, when we are sure everything appeared to you to be lost. We are more than pleased with the results which you have obtained, and we must again thank you, for without the old A.R.R.L. amateur radio would have been completely washed out.

—A. Reid, S.C.M.

A little study of the waves we have left shows that it is time to get busy and prove that the American ham cannot be stumped by these handicaps, and the gang will have to scratch their heads and make 5 and 10 meters do their stuff. I suppose when we get these bands the way 40 and 20 are now, we will get bounced down to 0 minus, eh? However, let to-morrow take care of itself, and get to work, for the new problem may prove a tougher one than we have tackled yet.

—Jos. A. Mullen, 1ASI.

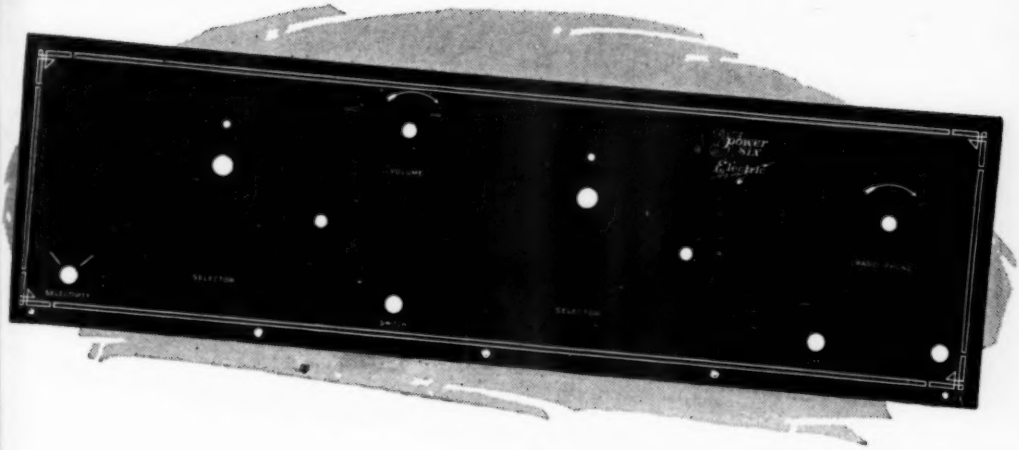
The Hackensack Radio Association of Hackensack, N. J., wishes to express the deepest admiration and thanks for your work and efforts on behalf of amateur and international amateur radio operations at the past International Conference at Washington. We are more than gratified for the amateur allocations, however meager, obtained by you and your colleagues, and hope most sincerely that the amateurs, world-wide, still continue with the A.R.R.L. and I.A.R.U. as a body, to further growth and development in spite of some curtailment.

—Hackensack Radio Association,
per Lloyd C. Wells, 2GE, Traffic Mgr.

We are so thankful that we have an A.R.R.L. and that the A.R.R.L. is fighting, tooth and nail, to keep the privileges of the amateur. Altho we have lost a little of each band, we all know that without the A.R.R.L. we would have a lot less than we have now.

—D. F. Cottam, 9BYA.

It is my opinion that the A.R.R.L. has done everything possible in connection with



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Bremer Tully Power Six Electric; Karas A-C Equamatic; Karas Knickerbocker Four and Tyrman "70" front and sub panels are recent additions to the Formica line. There are also available panels for battery sets of the same makes and the World's Record Ten; H. F. L. Nine-In-Line; Magnaformer front and sub panels; Madison-Moore; Melo-Heald; Camfield Nine and many others. :: ::

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Low price of $2.50 each make them available to every Ham.

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Rectobulbs: get ready for the tests—increase the efficiency of your station by adding a pair of Rectobulbs; indorsed by many of the leading Hams. Price $15 each.

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| Repair price on | 203 | $15.00 |
| | 204 | $50.00 |
| 203A | (Tungsten filament) | $19.00 |
| 204A | " " | $50.00 |

**NATIONAL RADIO TUBE CO.**

**(6EX) 3420 18th St. San Francisco, Cal.**

**(A ham institution)**


the alloting of the amateur bands. Many people cry before they think, and they do not realize we are mighty lucky to have all the territory we now use.

—Bruce Hoag, 8AXA.

In view of all of the circumstances and the strong opposition from European nations I feel that the League is particularly fortunate in retaining as much space as has been agreed upon, and I congratulate our people at headquarters upon the work which they have done in this connection. Very likely, had it not been for the concerted action on the part of the League representatives, the amateurs would have had little or no consideration.

—William W. Porter, New York.

## Some More Abbreviations

2533 Herschel Street,
Jacksonville, Fla.

Editor, *QST:*

Seeing as it is all the rage lately to think up more abbreviations to add to CQs, I want to offer one or two more that the gang should find to be very useful.

YNB—Yes! We have no bananas.
YLB—My YL is a blond.
YLB—My YL is a brunette.
WCT—We chew tobacco.
NCC—Not a cough in a carload.
GLD—Good to the last drop.

Maybe after I've disconnected the universal joint from the r.f. choke, I can think of some more.

Honestly, though, it seems that in every *QST* lately somebody has some more CQ additions to offer. I suggest we call a halt. No doubt, some of them are good but how many use 'em and who remembers what they are when they hear 'em?

And say, K. B. W. or whoever is the guilty party, we sure do appreciate the hard work you put in for us at the big conference. If it hadn't been for you, *QST* would make a million off of ham ads offering junked radio apparatus for sale.

—*John H. Webb, 4NE.*

## European DX

Aboard S. S. *American Shipper*

Editor, *QST:*

Just a point or so concerning DX on the forty-meter band as I have heard it in Europe.

In the first place, a majority of American amateurs are believers in the idea that most European DX can be worked by sticking right close to 37.5 meters. After being in Europe and keeping watch on the forty-meter band, I will say that twice the number of signals were logged on waves in the middle and upper parts of the band than were logged in the near vicinity of 37.5 meters. The lower end of the band is completely covered with high powered European commercial stations and even NAA comes in with kick enough to QRM any amateur signal on a nearby wave.

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*(As Well as Amateurs)*

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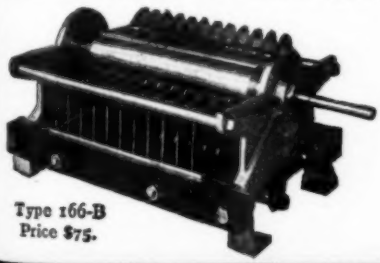
| | | |
|---|---|---|
| WAAM — Newark | WBBC — Brooklyn | WBAK — Harrisburg |
| WARS — Brighton Beach | WCFL — Chicago | WBNY — New York |
| WCOA — Pensacola | WCBI — Scranton | WFDF — Flint |
| WEAF — New York | WFJC — Akron | WGMU — New York |
| WGCP — New York | WEBW — Beloit | WHN — New York |
| WLW — Cincinnati | WEMC — Berrien Springs | WKBQ — New York |
| WMCA — New York | WKBO — Jersey City | WLBW — Oil City |
| WKRC — Cincinnati | WLTH — Brooklyn | WMSG — New York |
| WMAK — Lockport | WNJ — Newark | WNAD — Norman, Okla. |
| WNBH — New Bedford | WNYC — New York | WPCH — New York |
| WRMU — New York | WTFF — Washington | WSMK — Dayton |
| WPSC — Pennsylvania | WSKC — Bay City | WSWS — Chicago |
| WJAF — Ferndale | KOIL — Council Bluffs | KOWW — Walla Walla |
| WQCB — Philadelphia | WEAN — Providence | WCWS — Danbury, Conn. |
| WJAG — Norfork, Neb. | KFKB — Milford, Kansas | KGCN — Concordia, Kan. |
| KGM — Picher, Okla. | WICC — Bridgeport | WSDA — Brooklyn |
| KGDR — San Antonio | WHK — Cleveland | KFUM — Colorado Springs |

STATIONS OF THE RADIO CORPORATION OF AMERICA
STATIONS OF THE WESTINGHOUSE ELECTRIC & MANUFACTURING CORPORATION
STATIONS OF THE AMERICAN TELEPHONE & TELEGRAPH COMPANY
STATIONS OF THE GENERAL ELECTRIC COMPANY

*—and many others—*

SINCE the inception of broadcasting, Cardwell has made a specialty of Condensers built particularly for the needs of powerful transmitters. Originally designed for commercial radio communication, they are the only condensers in regular production which are suitable for use with more than 500 Watts output, and have become standard for antenna, tank circuit, neutralizing, and every other use where a low loss fixed or variable capacity is necessary.



Type 166-B
Price $75.

FOR use in Amateur Transmitters and low powered commercial installations, the regular line of Cardwell Condensers is unsurpassed.

Write for full particulars and prices, giving all possible information as to voltage, circuit and current.

**The Allen D. Cardwell Mfg. Corp.**

81 Prospect St. Brooklyn, New York

# Condensers

"THE STANDARD OF COMPARISON"

**And NOW the VOLUME CONTROL CLAROSTAT**

HERE'S big resistance in small package—and at low cost. What's more——

RESISTANCE range of 0-500,000 ohms in several turns of knob for micrometric adjustment. Handsomely nickel plated with new style bakelite knob. One-hole mounting. Screw binding posts. Takes up little room. A real Clarostat through and through—noiseless, stays put, trouble-proof and lives long. And only $1.50.

AS the baby member of the family, the Volume Control Clarostat is intended for receiving set applications. Use it as the control for plate voltage, volume, tone, regeneration, stabilization, balancing, and many other purposes requiring light-duty resistance. Meanwhile, don't forget the Standard (20-watt) and the Power (40-watt) Clarostats for the big jobs in power supply units, line-voltage control, power amplifiers and transmitters.

COMES in the familiar green box, with CLAROSTAT stamped on shell. Watch out for substitutes!

*Ask your dealer to show you the Clarostat line. Or write us direct for the dope.*

**American Mechanical Laboratories, Inc**

*Specialists in Variable Resistors*

285-87 North 6th St. **Brooklyn, N. Y.**

MEMBER RMA

My advice is to keep above 38 meters if you want to get through. I hope this suggestion is of benefit to someone.

—*John H. Gullans.*

## Grinding Quartz

P. O. Box 172,
University Station,
Tucson, Arizona

Editor, *QST:*

Some time ago I noticed an article on crystal grinding in *QST*. I do not have my back files at hand but as nearly as I remember, the article suggested that a couple of milled iron or steel plates be used as grinding surfaces.

Having done a little work along this line in the past few months, I have found what I believe to be a better method of doing this besides being much cheaper, a point which usually brings joy to some ham's heart.

I have found it quite satisfactory to merely use a couple of pieces of high grade plate glass. These may be obtained for nothing or, at the worst, for a few cents and therefore save all the time and expense of having to mill the steel or iron plates. The glass probably has a smoother surface than the steel would have anyway. There is another distinct advantage in the use of glass and that is its hardness. While it is not as hard as the quartz, it will be found that the wear on glass is decidedly less for a given amount of grinding than the steel. This, I believe, is of importance since the surfaces must be absolutely plane and parallel. While it is possible to have a variation in thickness of as much as a thousandth of an inch in a two hundred meter crystal and still get fairly satisfactory results, an error this large in an eighty meter crystal will ruin it. If added weight is desired, a chunk of iron may be cemented to the glass plate. The iron, if used, should cover the entire glass uniformly to avoid any tendency of the glass to bend.

I hope this hint may prove of help to someone.

—*M. W. Bannister, 6CDY-6CPK-KGAR.*

## Rubber Stamp

2216 Madison Street,
Chicago, Ill.

Editor, *QST:*

A majority of recent articles published in *QST* dealing with traffic regulation and best methods of dispatch contain in their text a growing resentment against messages of the rubber-stamp variety.

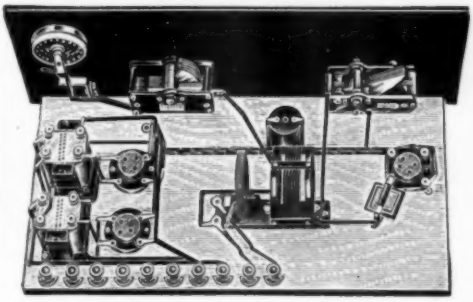
It is difficult to imagine what the result of their extermination would be, since it is almost impossible to serve the public either in professional or amateur circles, with reservations which may appear to facilitate traffic yet are more apt to hinder an organization's progress towards complete national recognition of its abilities.

The delivery of a message of no tangible importance, except as a greeting or trans-

# The AERO Short Wave Receiver

SUPER-Sensitive SUPER-Selective SUPER-Flexible

*The Finest Short Wave Receiver*



*Build It Yourself— Right Away!*

## Superlative performance in every respect assured by carefully selected parts around which set is built

If you want a **real** short wave receiver—a set possessing unusually long range, fine selectivity, great power and splendid tone qualities—build the AERO SHORT WAVE RECEIVER.

This excellent receiver is neat and compact, and is flexible to an unparalleled degree. It has a normal range of 15 to 130 meters, and completely covers U. S. bands 20, 40 and 80 meters. Range can be reduced or increased if desired (see note below). Any amateur desiring the very best in short wave reception should certainly build this set.

## These Parts Make Possible Its Excellent Performance

**AERO PRODUCTS, Inc.**
Supersensitive AERO Coils, in the form of the AERO Low Wave Tuner Kit, play a big part. This kit consists of 3 interchangeable coils. Special patented construction reduces high frequency losses to a minimum. Price of kit, $12.50. You can lower range of set to 13 meters with AERO INT. 0, or increase range to 725 meters with AERO INT. 4 and INT. 5. These coils priced at $4.00 each. The AERO Choke and AERO Foundation Unit are also used.

**AMSCO PRODUCTS, Inc.**
AMSCO Condensers are another important factor in the AERO SHORT WAVE. One .00014 condenser and one .00025 condenser are used. These list at $2.75 and $3.00 respectively. AMSCO parts are noted for their accuracy, dependability and fine construction.

**THORDARSON ELECTRIC MFG. CO.**
THORDARSON radio transformers are particularly desirable in the AERO RECEIVER. For code work the R-151 6 to 1 ratio transformers give maximum amplification at 500 cycles. For short wave reception of broadcasting type R-152 or R-200 will give excellent volume and tone quality. As used in this set, these transformers leave nothing left to be desired.

**YAXLEY MFG. CO.**
You'll like the outstanding quality and neat finish of the YAXLEY battery switch, resistances and rheostat. These items contribute much to this receiver's beautiful finished appearance and electrical efficiency.

**BENJAMIN ELECTRIC CO.**
BENJAMIN sockets insure utmost electrical efficiency. That's why they're specified in this receiver.

**X-L MANUFACTURING CO.**
X-L binding posts are used, of course. Neatly finished—and 100% efficient.

**CARTER RADIO CO.**
The products of this well-known manufacturer also contribute to the merits of this circuit.

***Any or all of these specified parts are available at your radio dealers. Get them today. For literature or further information regarding the AERO SHORT WAVE RECEIVER address***

## AERO PRODUCTS, Inc.

Dept. 16 1772 Wilson Ave. Chicago, Ill.

## How to be a commercial Radio Operator

A practical book that should enable anyone of average intelligence to pass the Government's theoretical examination given to applicants for a Commercial Radio Operator's License.

**JUST OUT**

**Nilson and Hornung's**

**PRACTICAL RADIO TELEGRAPHY**

**380 pages, 5x8, 223 illustrations**
**$3.00 net, postpaid**

The book covers in detail the theory and practical operation of every type of modern, 1928, commercial arc, spark, and vacuum tube transmitter. It furnishes complete data on commercial vacuum tube receivers. It covers everything from elementary electricity to the practical operation of radio compasses.

**Some outstanding points**

1. Very little mathematics;
2. Assumes no prior knowledge of electricity;
3. Covers everything in commercial radio in detail;
4. Complete list of self-examination questions;
5. Simple, yet rigidly accurate;
6. Complete wiring diagrams given.

See the book before you purchase. Fill in and mail just this coupon.

**McGRAW-HILL FREE EXAMINATION COUPON**

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You may send me Nilson and Hornung's PRACTICAL RADIO TELEGRAPHY, $3.00 net, postpaid. I will either return the book, postage prepaid, in 10 days, or remit for it at that time.

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*QST*. 2-1-28

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**THE EASTERN RADIO INSTITUTE can train you quickly and thoroughly because:**

**MODERN AND EFFICIENT METHODS**
**THOROUGH INSTRUCTION under staff of LICENSED COMMERCIAL OPERATORS**
**MODERN APPARATUS including SHORT WAVE TRANSMITTER**
**FIFTEEN years a RADIO SCHOOL**
**THE OLDEST, LARGEST and MOST SUCCESSFUL school in New England. RECOMMENDED BY THE A. R. R. L.**
**Day or Evening Classes Start Every Monday.**
**SPECIAL CODE CLASSES**

*Write for Illustrated Prospectus*

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fer of personalities, probably does not provoke within an operator a feeling of heroic work akin to locating lost trains or directing rescue work on a gigantic scale, the effect of which is felt by thousands, yet any organization devoted to the relaying of radio traffic is bound to have its standards lowered if the personnel refuse to transmit or deliver a radiogram due to its seeming unimportance.

These messages finding their destination more often in the station waste-basket, should be cherished by the amateurs as the life-blood of their organization: the means of constantly exploring for easier and more definite lanes of traffic: the opportunity to increase operating ability which will stand in good stead when needed most, and last but not least, convince the public the amateurs are a body of genuine non-professional operators that accomplish their work, whether to their likes or dislikes, in a professional fashion that shows reliability and systematic perfection.

*—Theo. R. Lowenthal, XG at 9AUE.*

## GBA and QSL

Bremerton, Wash'n.

Editor, *QST:*

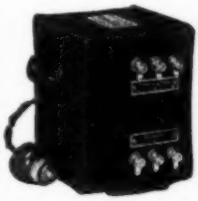
Although I have not been a ham for years and years, in fact only for the period of four months, I would like to bring a thought to this wonderful organization. That is, please give sufficient address on messages. Insufficient addresses cause more undelivered traffic than anything else. It takes so little time for the originating station to obtain a complete address that there seems to be no excuse for not getting it. How many of you fellows have received a message addressed, for instance, John Howard, Philadelphia, Pa.? Makes you feel real good, don't it, trying to locate him? Although this town is not as large as one-fourth of Pennsylvania's proud city, it is no small matter to locate anyone without a sufficient address. During my four months as a ham, I've handled just ten so addressed messages. After every means was exhausted in trying to locate the addressee they were finally mailed but all returned unclaimed except three. On servicing this to the originating station, no reply has been received to date to my request to GBA. What say fellows if we remedy this immediately?

Then those QSL cards. I'm no millionair but I will QSL to every ham I work whether he is five or five thousand miles distant. But don't it make you sore when after weeks and weeks you get not a card in return after the other fellow says, "Pse QSL OM I'll do the same." If you don't intend to QSL, OM. do you think it fair to ask for one? My QSL returns to date are twenty-five percent. Lets rectify this too. What say?

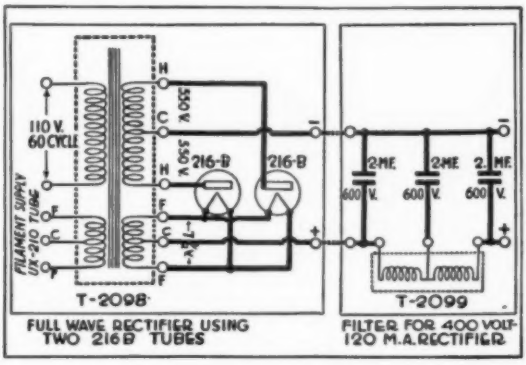
*—R. J. Marion, 7AHV.*

# POWER FOR YOUR 210 TRANSMITTER

This Thordarson 130 M.A. power supply unit will operate your 210 Transmitter at full capacity. The excellent filtering improves audibility by "sweetening" your note. This unit when in operation in the 9-J C Transmitter was reported from coast to coast at R-5 with a pure D. C. note.



T-2098




FULL WAVE RECTIFIER USING TWO 216-B TUBES

FILTER FOR 400 VOLT 120 M.A. RECTIFIER

T-2099

**Power Supply Transformer T-2098**

Designed for use in amateur transmission and heavy duty power amplifiers using two UX-281 or two Ux-216-B rectifiers. Primary 110-115 volts 50-60 cycles. Secondary No. 1—550 volts each side of center. Secondary No. 2—7½ volts, 2½ amperes center tapped. Secondary No. 3 same as secondary No. 2. Price **$20.00.**

**Double Choke Unit T-2099**

Consists of two individual chokes of 30 henries, 130 M.A., each. Designed as filter chokes for power supply transformer T-2098. Chokes mounted in crackle finished compound filled case. Dimensions 3¼" x 4⅞" x 5⅝" high. Price **$14.00.**

**NEW**

**THORDARSON**

**Plate and Filament Transformers**

**A Complete new line of Thordarson long distance transmission equipment has just been released including filament supply, plate supply and microphone transformers and filter reactors for use with all existing transmitting tubes.**

**WRITE FOR YOUR CATALOG TODAY**

**THORDARSON ELECTRIC MANUFACTURING CO.**

*Transformer specialists since 1895*

**WORLD'S OLDEST AND LARGEST EXCLUSIVE TRANSFORMER MAKERS**

***Chicago, U.S.A.***

3574

## A Simple Guide for Selecting Resistors

No matter how many claims are made for a resistor, you can always check up on its true worth by finding out who uses that particular make, and how it stands up under the rigid pressure of daily service.

We strongly recommend that you ask any one of the following companies about Harfield Resistors. They are but a few of a great number of concerns now purchasing Harfield Resistors in large quantities.

Stromberg-Carlson Telephone Mfg. Co.
Crosley Radio Corporation
American Transformer Co.
Fansteel Products Co.
Martin Copeland Co.
Splitdorf Electric Co.
Western Union Teleg'h Co.
Sonora Phonograph Co.
Conner-Crouse Corp.
Magnavox Corporation
Electrical Research Laboratories
Samson Electric Co.

*Tell us about the resistor you want and let us make up a sample for you with prices. Write to*

HARDWICK, FIELD, INC.

FACTORY
215 Emmet St.
Newark, N. J.

HAR-FIELD
WIRE-WOUND
RESISTORS

SALES DEPT.
100 Fifth Ave.
New York City

Licensed under Andrews-Haum...ent pending

The truest and clearest AC Electric Radio is a standard set equipped with Balkite Electric "AB" $64.50 and $74.50. *Ask your dealer.*

Balkite
*Radio Power Units*


## I. A. R. U. News

*(Continued from Page 56)*

8FD made contacts with this station, the 33.5-meter signals of which are heard QSA at night."

—*J. Reyt, ef8FD.*

Page 64 of the November *QST* carried a report from Mr. C. Conte concerning receiving conditions on the 40-meter band. He reports that during the month of November, conditions changed somewhat for the better and he was able to log more than two-hundred U.S.A. signals. However, it is not yet possible to count on a satisfactory daily service between the U.S.A. and France and most everyone is complaining that signals continue to be weak and unreliable.

During this month, he has found that the best time for receiving "nu" signals is between 0500 and 0600 G.C.T. During all but about five or six days, receiving conditions were extremely good between these hours.

It has also been noticed that in many instances, even though nu signals are being heard, the French signals do not seem to get over and two-way contacts cannot be obtained. The ninth U. S. district is the most consistent of all in getting over.

### JAPAN

We have received word of the licensing of another amateur station under the call letters of JXIX. The owner of this station is K. Kasahara who will be better recognized as being old 3AA. The watts output are limited to 7 and we also understand

A LOOK AT JXAX

that the working hours of all these stations are limited and specified in their licenses. The hours do not seem to be uniform for all stations as JXAX works from 0900 to 2100 G.C.T. on week days, all day Sunday and on all holidays, while JXIX works from 0100 to 0300, 0500 to 0600, 0700 to 0900, 1300 to 1500, and 2100- to 2300 G. C. T. It is probable that the other licensed stations have still different hours assigned to them for operation.

# *Most of the better sets are Faradon equipped*

**In high grade Radio Receiving and Broadcasting equipment you will find Faradon Capacitors the accepted favorite.**

**Amateurs as well as manufacturers know that Faradon is the unit which may be specified and used with complete confidence that it will give unvarying and long lived service.**

**Regular production will take care of most requirements. Write our Engineering Department regarding any unusual condenser problem.**

**WIRELESS SPECIALTY APPARATUS COMPANY**

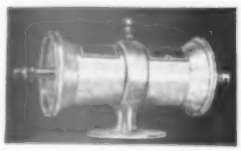
**Jamaica Plain**
**Boston, Mass., U. S. A.**

***Established 1907***

# Faradon

*Electrostatic Condensers for All Purposes*

1458



UC 1846

UC 1803

## High Voltage Condensers

*For* Tuned Plate
Tuned Grid Circuits

These low capacity, high voltage condensers are ideal for short-wave transmitting grid and plate blocking condensers, particularly in the popular and efficient tuned-plate—tuned-grid circuit.

UC1846 is a double unit having two sections of .000037 μfd. each. It is insulated with sulphur, one of the best insulators, and will withstand 10,000 volts. Price $1.00.

UC1803 is a single unit of .000025 μfd. capacity and voltage rating of 10,000 volts. Can be inverted and mounted on G. R. pillar insulators. Price 50 cents.

Postage prepaid

**UTILITY RADIO COMPANY**

80 LESLIE ST. EAST ORANGE, N. J.



C R O S L E Y

AC BANDBOX

the leading radio of today

$90

Without Tubes

The Crosley Bandbox is now supplied in two models—the 602 in which the power department is separate from the receiver and the 704 in which it is housed in the same case. The two models are identical—there being no difference in the amazing performance which so definitely marks the Bandbox 1928 **greatest** radio.

A genuine Neutrodyne! A high degree of sensitivity! Amazing selectivity! Compare the Bandbox with any set. Convince yourself of its superiority, visit your nearest dealer and hear its wonderful performance. Write Dept. 18 for descriptive literature.

**The Crosley Radio Corporation**

Powel Crosley, Jr., Pres. Cincinnati, Ohio

Montana, Wyoming, Colorado, New Mexico and West, prices slightly higher.

~~CROSLEY~~ ~~RADIO~~

Crosley is licensed only for Radio Amateur, Experimental, and Broadcast Reception.

NEUTRODYNE


JXCX and JXDX are allowed only two watts output and except for JXAX who is allowed 10 watts all the others are licensed for powers not exceeding 4 watts.

The accompanying photo shows the operator of station JXAX as well as part of the station. The operator and owner is Mr. K. Kusama who is one of the leading amateurs of Japan and is an active member of the J.A.R.L.

The transmitter is a crystal controlled one employing a 152-meter crystal driving a Cymotron 201-A type tube with 96 volts on the plate. The first amplifier stage acts as a frequency doubler and also uses the same type tube and the same plate voltage as the crystal circuit. The second amplifier is also a frequency doubler with its output on 38 meters. A 202 is used with 190 volts applied to the plate. The third amplifier (and last stage) consists of a Cymotron 203-A with 1,000 volts on the plate. This is a straight amplifier and is not used as a frequency doubler. The antenna is a single wire 8.5 meters long and 13 meters high and the counterpoise is 8 meters long and 5 meters high.

The crystal was made in Japan and the Cymotron tubes are manufactured by the Tokio Electric Company (it will be remembered that JKZB, the experimental station, is located in this factory) and are similar to those radiotrons, the type numbers of which they bear.

The station is allowed to use phone transmission. Both the carbon grain type and some special microphones employing moving iron armatures are employed. The two stage amplifier that follows the microphone has such constants as to tend to compensate for any distortion in the microphones themselves. The second stage is a push-pull affair using power tubes, the output of which is fed to the grid circuit of the last amplifier in the transmitter.

Jacks are inserted in the grid and plate circuits of all the amplifier stages in the transmitter so that a milliammeter may be readily plugged in and the current flowing in those circuits measured. In order to facilitate such readings, the jacks are all mounted on one panel.

The power for the transmitter is obtained from the 110-volt, 60-cycle supply line. A home-made filament transformer is used in conjunction with a home-made auto transformer by means of which the voltage applied to the filaments is controlled. The plate is supplied from a 1 Kw. step-up transformer. A rectifier of the electrolytic type consisting of sixteen cells in test tubes is used and it is possible to rectify voltages up to 1200 with it. The filter uses some home-made electrolytic condensers and a 100-henry choke. As part of the filter, there is a storage battery of 1,000 volts which is floated across the line. This might seem to be expensive but only costs 6 yen or roughly three dollars, American money. A Westinghouse motor-generator giving 500 volts is also available for plate supply as are three 96-volt, 1.5-amperehour storage

# Cunningham RADIO TUBES

*The AC way is the modern way*

*for better reception with any A C set, use*

**CUNNINGHAM**

**A C Tubes CX 326 and C 327**

These tubes eliminate batteries—just plug into your house lighting circuit and enjoy modern radio reception. It is just that simple.

**E. T. CUNNINGHAM, Inc.**

NEW YORK CHICAGO SAN FRANCISCO

YAXLEY
APPROVED RADIO PRODUCTS

**Radio Convenience Outlets**

**Wire Your Home For Radio**

Enjoy your radio programs in any room in the house. Put the batteries in any out-of-the-way place. Bring aerial and ground connections to most convenient point. These outlets fit any standard switch box. Full instructions with each outlet.

No. 135—For Loud Speaker ..... $1.00
No. 137—For Battery Connections ..... 2.50
No. 136—For Aerial and Ground ..... 1.00
Also furnished in two and three plate gang combinations

**With Bakelite Plates**

Now furnished with a rich satin brown Bakelite plate, with beautiful markings to harmonize, at 25 cents extra. See illustration. *At Your Dealers*

YAXLEY MFG. CO.
Dept. S-9 So. Clinton St. Chicago, Illinois

SANGAMO
AUDIO TRANSFORMERS

*for* REAL *realism*

Flawless realism in reproduction! What radio enthusiasts and music lovers have hoped for and radio engineers have striven for since the inception of radio.

A dream that is coming true! The new Sangamo Transformer will help. Every tone over the entire musical scale is amplified uniformly. With proper transmission, an appropriate circuit, Sangamo Audio Transformers and a good reproducer the result is flawless realism...even to the ear of the trained musician.

*3 to 1 ratio* *Price* **$10**

*Sangamo Mica Condensers are accurate and stay accurate.*

Sangamo Electric Company
Springfield, Illinois

batteries and 200 volts of dry cells which are used for grid bias.

SOUTH AFRICA

"Of late, DX has been consistently good, conditions having greatly improved here.

"The 'fo' amateurs have been in communication with all continents, with such stations as odPK1, ai2KT, nu6HM, ai2KX and ef8IX figuring most prominently.

"foA3V is to be commended for his good work in having been in communications with stations on all continents within a period of twelve days. Hill of foA3Z is to be congratulated on the winning the S.A.R.R.L. HOS Trophy for the second time. The recent competition for this Trophy, which is confined to South Africa, resulted in the following scores:

| | |
|---|---|
| foA3Z, B. Hill | 138 points. |
| foA8G, D. Richardson | 134 points. |
| foA5L, J. Malan | 118 points. |

A close finish and a good one which kept everyone deeply interested.

"A new recruit to the ranks is our old friend, W. Hilarius who is chief engineer to the African Broadcasting Company. His call is A9X and needless to say, we expect quite a lot from him. Another one to join the fold is OM Perry. As A9Z has been alloted to him, we are wondering what the next call letter to be issued will be.

"A special sub-committee of the S.A.R.R.L. will hold a meeting soon with a view to changing the constitution so as to make it conform with the I.A.R.U.

"The 36-hour test sent out by 5SW in England came through with remarkable clarity and volume. However, as might be expected, when it came time for the official opening, everything had changed and the results were very poor. On Saturdays at about 2100 G.C.T., 2XAD has been reported as R7 to R8 and in my own particular case it could have been made an R9 plus.

"A3V and nu1CMX have clicked for the first time since the 'fade out' which occurs each year and separates us from our many nu friends."

*—F. P. Marks, foA5F.*

U. S. S. R.

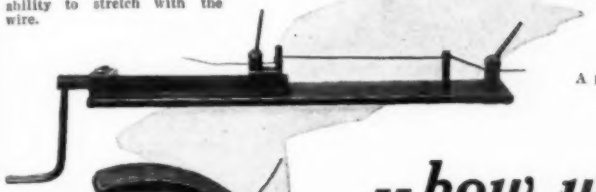
"During the summer further developments have taken place in amateur radio in the U.S.S.R. although perhaps not as great as has occurred in some other countries.

"We have now an official organization of short-wave enthusiasts which is known as he Short-Wave Section (called S.K.W.) of the Wireless Friends Society of the U.S.S.R. which is referred to as the O.D.R. QSL cards for eu, as and ag stations may be addressed to that organization for handling. Address as follows: Moscow, U.S.S.R., Polytechnic Museum 124, Wireless Friends Society of the U.S.S.R., S.K.W.

"Information concerning our activities appears in our publication called, RA-QSO-RK. The first issue of it made its appearance in April of 1927 so that it is now a

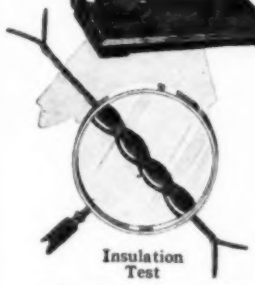
# Enameled Magnet Wire

**Elongation Test**
shows the elasticity of the enamel insulation and its ability to stretch with the wire.



**Mercury Bath Test**
A positive method of detecting and guarding against imperfections in the enamel insulation.

**Reactance Test**
Determines the softness of the wire. Checks the completeness and uniformity of the annealing.



**Insulation Test**
Measures the dielectric strength of the enamel insulation by determining the voltage required to break it down.

## --how would YOU test it?

Regardless of how varied or severe your tests might be, Dudlo enameled wire has already been subjected to a series of scientific tests at the factory, covering every physical or electrical characteristic required for any purpose.

Besides the four tests illustrated here, a number of others regularly employed including the "Ageing" test to determine the ability of the enamel to stand up under heat over continued use—also the "insolubility" test proving the qualities of the insulation to resist the effects of oil, water, varnish, etc.

Thus Dudlo protects the quality of *your products* by constantly maintaining the highest possible standard of its own.

# DUDLO

**DUDLO MANUFACTURING COMPANY, FORT WAYNE, INDIANA**

**DIVISION OF THE GENERAL CABLE CORP.**

56 Earl Street, Newark, N. J.
160 North La Salle Street, Chicago, Ill.
4153 Bingham Ave., St. Louis, Mo.
274 Brannan Street, San Francisco, California

New!

Centralab
Power Rheostat

This new unit is a knock-out for warp-proof, heat-proof performance. Its construction permits continuous operation at temperatures of 482° F. and beyond. Resistance wire is wound on metal core, asbestos-insulated; core expands with wire, insuring smooth action. Narrow resistance strips give small resistance jumps per turn, further assurance of even regulation. Compact 2" diameter. Ohms—500, 250, 150, 50, 15, 6, 3, .2, .5—price $1.25. Can also be furnished as a potentiometer. At dealer's, or C. O. D. You need this new Power Rheostat. Send postal for new circuit literature.

CENTRAL RADIO LABORATORIES
20 Keefe Avenue Milwaukee, Wis.

Centralab

LIST PRICE
$13.50

Convert Your Set to A. C. With the NEW Karas A-C-FORMER. Easy to Do—No Rewiring.

You now can have A. C. operation of your present battery operated receiver by using the new Karas A-C-Former Filament Supply and the Carter Adapter Cable Harness now available. You can then use the new A. C. Tubes and enjoy the marvelous reception they afford—get distant stations with tremendous volume—be forever free from battery operation. Easy to convert your set. No rewiring. Simply remove present tubes, insert Carter Adapter Cable Harness, attach end of harness to Karas A-C-Former, and put in new A. C. Tubes. Anyone can do it in a few minutes. Mail coupon today for full information on how to convert your set.

KARAS ELECTRIC COMPANY
4030-B North Rockwell St., Chicago

Karas Electric Co.,
4030-B No. Rockwell St., Chicago.
Send me complete details on how I can convert my .....
tube ..... receiver to A. C.
Name .....
Address .....
City ..... State .....


half year old. It is published as an enclosure of the official organ of the O.D.R., Radio Wsiem. (apparently some distortion occurred in the translation of this name) which gives it a wide circulation of somewhat more than 22,000 copies. The enclosure is now of eight pages but it is hoped and expected that it will be of sixteen pages in the near future.

"The Commissariat of Posts and Telegraph recently advertised that all amateurs that are members of the S.K.W. would not be charged for their licenses. Licenses will be issued to every one applying for them who has a recommendation from the S.K.W. (Previously it was required that one get a recommendation from some recognized radio laboratory before a license would be issued. Assist. Tech. Ed.) Applicants to the S.K.W. will not be given such recommendations unless they already have a short-wave receiver and know a little Morse. We are, of course, very glad that licenses may be now obtained but believe that strict regulations must be maintained for the good of all concerned.

"We now have about sixty licensed transmitting stations and approximately three hundred and fifty registered short-wave receiving stations. In spite of the ease with which licenses may be obtained, some of our stations are still operating under their old call letters, their owners having apparently made no effort to obtain the necessary papers.

"The Commissariat of Post and Telegraph has not accepted the suggested new arrangement of call letters which would call for the dividing up of the country into districts such as is now in force in the U. S. A. We shall therefore continue to use the present system with the letters RA either followed or preceded by two numbers.

"The general public is now showing a keen interest in short-wave work and several of the 'popular' radio magazines are devoting special pages to it under the direction of prominent scientists and specialists in this branch of radio. It can only result in additions to our ranks.

"We now have some short-wave commercial stations in operation and there are several amateurs in the army who are operating transmitters. It is very pleasant to be able to look at a map and see that in practically every big town there is at least one amateur station in existence. The cities of Nijni-Novgorod, Moscow, Leningrad and Tomsk have the largest number of stations.

"A test to show whether or not reliable and consistent communication could be established between European and Asiatic parts of the Union was conducted recently. Though contacts between these extremities of our country were established, they were not very durable.

"Our best contacts are made with South American stations and for several hours during each day of the week, we are able

# *In September we published this advertisement:*

## $4 Worth of Book for $1

SOMEBODY got to figuring not long ago and made some interesting discoveries about THE RADIO AMATEUR'S HANDBOOK. They show what we mean when we say the Handbook is the biggest dollar's worth of radio literature ever offered.

This Handbook is not printed in the fashion of an ordinary book. Books are printed in relatively large type, lines clear across the page, space between lines. We found it more convenient to print the Handbook after the fashion of QST—the same size page, the same size type, and the same two columns to the page. The result is that the Handbook has that same often-unrealized quality of QST—it has an astonishing number of words between its covers. It runs three times as many words to the page as an ordinary book. If printed after the ordinary fashion of books, the Handbook would have over 500 pages!

Let's get a complete comparison. Everybody knows Ballantine's "Radio Telephony for Amateurs", universally admitted to be an extremely valuable book for every amateur. The A.R.R.L. Handbook, "The Radio Amateur's Handbook", has nearly twice as many words as Ballantine! Is Ballantine worth its $2? You know it is. Is Ballantine profusely illustrated? The Handbook has thirty more illustrations in it than Ballantine.

If the Handbook had been produced like an ordinary book it couldn't have been sold for less than $4. Now you know what we mean when we say the Handbook will represent the best dollar you ever spent.

"THE RADIO AMATEUR'S HANDBOOK"

**A Manual of Amateur Short-Wave Radiotelegraphic Communication**

By F. E. Handy, A.R.R.L. Communications Manager

Price $1 Postpaid Anywhere

Published by

**American Radio Relay League, : Hartford, Conn.**

## *—and now the new, revised, 3rd edition, 32 pages larger and up-to-the-minute, is available!*

*for*
*power circuits*

It has become standard practice to use Parvolt Wound Condensers in circuits which quickly break down ordinary by-pass or filter condensers.

You will find that the same characteristics of accuracy, high direct current resistance, and the ability to give continuous duty at full rated voltage, make them desirable in circuits where even a poor condenser might "get by."

THE ACME WIRE COMPANY
New Haven, Connecticut

PARVOLT
WOUND CONDENSERS

6131-4

FROST-RADIO FROST-RADIO FROST-RADIO FROST-RADIO FROST-

FROST-RADIO

WONDERFULLY BETTER
FOR EVERY SET

Frost Radio Metal Frame and Bakelite Rheostats are not only the smallest and most compact rheostats made, but they have velvety-smooth action and windings of finest Nichrome or Chromel A wire. Due to number of turns used these rheostats will keep cool under the heaviest load for which they are designed. Complete with Bakelite pointer knob. Resistances from 2 to 75 ohms. List: Metal Frame, 75c; Bakelite, $1.00.

*Write for Them*

WE OFFER readers of Q.S.T. two valuable new Frost-Radio publications free on request: "What Set Shall I Build?" the answer to a question which puzzles many set builders, and the new Frost booklet "For Better Reception," a complete and helpful manual of Frost Parts. Every set builder should have both of these booklets. They will be found chock-full of useful information that is right up to the minute. Fill out and mail coupon below for your copies.

HERBERT H. FROST, Inc.
Main Office and Factory, Elkhart, Indiana
Chicago New York

HERBERT H. FROST, Inc.
160 North La Salle Street, Chicago
Please send me free your two booklets, as advertised in Q.S.T. for February.

Name .....
Street Address .....
City ..... State.....

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# MORE SPECIAL OFFERS

## UNI-RECTRON POWER AMPLIFIERS

**MODEL AP-935**

AS the Uni-Rectron stands it is a super power-amplifier which can be used in connection with any radio set and loud speaker. Binding posts are provided for input to the Uni-Rectron and for output to a loud speaker.

If it is desired to use the unit as a source of high voltage supply (375 volts) for a UX-210 socket in the Uni-Rectron, so that the oscillator tube may be placed close to the transmitting inductance in order to keep the oscillating leads as short as possible.

The Uni-Rectron is, therefore, a double duty device —it is a high grade power amplifier, which by removing the input and output transformers, can be also used as a source of power for an oscillating, or transmitting tube, furnishing power for all circuits, grid, plate and filament. Uses a UX-216 B or 281 rectifying tube and a UX-210 power amplifying tube.

The cheapest form of Power Supply for Amateur Transmitting purposes ever offered. Every one new and packed in original factory cartons.

**LIST PRICE $88.50**
**(Without Tubes)**

**SPECIAL at $19.75 EA.**

## KENOTRON RECTIFYING TUBES

**(TYPE T. B. 1)** **MFD. BY GENERAL ELEC. CO.**

These rectifying tubes operate on a filament voltage from 8 to 10 Volts and draw 1½ amps. They will safely stand an A.C. input voltage up to 750 Volts and pass plenty of current and voltage for the plate of the Transmitting Tubes.

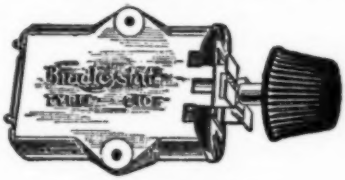
They are also very efficient rectifiers for use in "B" Battery Eliminators.

**STANDARD BASE**
**NEW IN ORIGINAL CARTONS**

**PRICE ONLY $1.25 EA.**

## TYPE E-210 BRADLEYSTATS

**MFD. BY ALLEN-BRADLEY CO.**



Bradleystat E 210 is a compact graphite disc rheostat well suited for filament and plate control applications.

By using it in the primary circuit of the Transformer the center tap is not displaced and the Transmitter efficiency is greatly improved.

One knob provides noiseless, stepless control.

Can also be used to control output of Eliminators or Power Packs. NEW.

**LIST $4.00**

**SPECIAL at $1.60 EA.**

**AMERICAN SALES CO., 21 Warren St., New York City**

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*for Distortionless Amplification*

12,000, 48,000, 50,000, 100,000 Ohms, List $1.50 each, Special Sizes to Order. $2.50 each. Dealers write for discounts. When Better Resistances are made they will be Crescents.

Cresradio Corp., 160-32 Jamaica Ave., Jamaica, N. Y

---

TOBE

*Write for Price List*

**Radio Interference Filters**

Take out noises in your radio caused by motors and household appliances. Requires NO attention. Over 1000 now in use.

Size No. 1 for small motors Up to 1-4 h. p. **$10**

Size No. 2 for larger equipment Up to 5 h. p. at 220 volts. **$15**

**TOBE DEUTSCHMANN CO.**
**CAMBRIDGE, MASS.**

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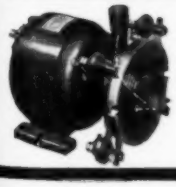


## *Get the* ADVANCE *"Sync"* RECTIFIER

GET this improved "Sync" Rectifier. Superiority proven by its prevailing use in international transmitting. Lower in price in spite of higher quality.

The Advance Sync Rectifier meets all requirements for heaviest duty. Improves all transmission—giving clearer tone and better volume. Can be easily and quickly filtered. Speedy starting. Requires no attention—always ready. With ¼ H.P. Westinghouse motor, $55.00 complete.

***Get the best. Write now for free descriptive folder***

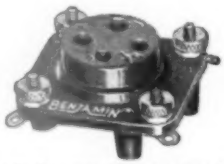
**ADVANCE ELECTRIC COMPANY**
**1260-1262 West Second St., Los Angeles, Calif.**

# BENJAMIN

## Cle-Ra-Tone Sockets

**Red Top** For Standard UX Type Tubes. For quick and easy finding of correct position of tube and prongs.

**GreenTop** A new Five Prong Socket for A. C. Detector Tubes. Especially designed for heavy current-carrying capacity for these new tubes.




Cle-Ra-Tone Sockets are spring supported to absorb the shocks that distort tonal qualities. The tube "floats" on four finely tempered springs, which absorb shocks and jars from slamming doors, passing traffic and other disturbances caused by outside vibrations. One-piece terminal to tube connection. Positive contacts. Knurled nuts for binding post connections or handy lugs for soldering.

*At All Radio Jobbers and Dealers*

**Benjamin Electric Mfg. Co.**

120-128 So. Sangamon St., Chicago

247 W. 17th St. New York — 448 Bryant St. San Francisco



# SAVE UR SHEKELS OM!

## High Quality Ham Goods

**No delays—prompt service. Money back guarantee. All standard apparatus. Lowest prices in the U. S.**

| | | |
|---|---|---|
| REL | 20-40 or 80 meter transmitting inductance double with coupling rods, complete | $8.85 each |
| AERO | 20-40 or 80 meter transmitting coil kits. Also 15-130m. S W. Receiving coils | $9.75 each |
| THORDARSON NEW TYPE | Combined plate and fil. transformers; 650 v. plate and two 7 1/2v. fil. windings, mid-taps | $6.20 |
| | 35 watt fil. trans. 8 v. with mid tap | $6.10 |
| | 150 " " " 12 v. " " " | $7.85 |
| | 100 " Plate " 350 and 550 v. " " | $13.90 |
| JEWELL | 3 in. Flush mount'g AC or DC voltmeters milliammeters—any scale readings | $5.95 |
| | Antenna thermo-ammeters, any scale reading | $9.80 |
| CARDWELL | New type Condensers T 199 .00035 mfd cond. T 183 B .00015 | $8.90 each |
| | " " " " 147 B .00045 | |
| GRID LEAKS | Large General Electric 5000 ohm | $1.45 |
| | " Ward-Leonard Cent. tap 5000 ohm | $2.45 |
| | Small Ward-Leonard Cent. tap 5000 ohm | $1.80 |
| | Crescent Lavite 5000 ohm special | $2.20 |

**FIXED CONDENSERS**

| | | |
|---|---|---|
| SANGAMO | Large .002 mfd. 500 volt | $ .50 |
| By-Pass | Up to .005, 3500 volt | 1.50 |
| Condensers | .002 mfd., 5000 volt | 1.75 |
| FLECHTHEIM | 2mfd 1000 volt | 2.75 |
| Guaranteed | 4mfd 1000 volt | 4.75 |
| Filter | 1mfd 2000 volt | 2.75 |
| Condensers | 2mfd 20 0 volt | 4.85 |
| | 4mfd 2000 volt | 6.95 |

(Flechtheim filter condensers are guaranteed against break down. Blown condensers will be promptly replaced without charge.)

PYREX STANDARD SOCKETS *For 202s, 210s, etc. **65c**

**RADIO 2MA CO.**

**168 Washington St., New York**


eg5BY, 6CKV, foA3Z, eg2NH, eg5KU, ac-8HB, 1PY, 6NX, 6CDW, oz4AO, oz3AR, 7DF, 1AZD, foA3X, eg5UW, ei1GW, 6KB, oa2RC, eb4BC, sb2AS, saGA2, 7RL, 9CCS, foA4L, 6BUX, su1FB, eg5HS, 2APD, ei-1RM, 6AZS, 1ON, eg6YD, eg5YK, 2GX 6BJL, 5AUZ, 2MD, 6DFE, 6AOI, su1CD, 9AEK, 6CAE, 6AM, oz4AM, 5WZ, gi6MU, sc2AB, foA6A, oh6BDL, sb2AX, 2CUQ and 6BZF.

Is your call in the list, OM?

---

## Calls Heard

*(Continued from Page 57)*

eb-4zz eb-k6 ee-earl ee-ear6 ef-8acz ef-8ba ef-8bf ef-8btr ef-8cp ef-8dmf ef-8eo ef-8fd ef-8ft ef-8gdb ef-8gi ef-8gm ef-8jf ef-8jo ef-8lmh ef-8lug ef-8raf ef-8rlt ef-8rp ef-8toy ef-8udi ef-8vvd ef-8xix ef-18gr eg-2bi eg-2dn eg-2gf eg-2kz eg-2nh eg-2sc eg-2xy eg-2yu eg-5ad eg-5by eg-5bd eg-5is eg-5ml eg-5sz eg-5yk eg-5yx eg-6nf eg-6oc eg-6rb eg-6rw eg-6vp eg-6wl eg-6yq eg-gi-2it eg-gi-8kg gw-1ib ei-1ay ei-1bd ei-1cn ei-1ea ei-1fo ei-1xw ei-1za ej-7qq ej-7xo ek-4aap ek-4aar ek-4abv ek-4dba ek-4oa ek-4uah ek-4xy ek-4yo en-opm ep-1aa ep-1be ep-1bk ep-1bl ep-3am ep-3gb ew-h4 ex-1as fl-1ab fm-8psrv fo-a3v fq-pm nb-be3 nd-hik ne-8ae ne-8af ne-8wg ng-uf nj-2pz nm-1l np-4oi np-4rx nq-2ef nq-2jt nq-2ro nq-2ac nq-5ev nq-5ry nq-7cx nr-2fg nr-cto nx-1xl oa-2no oa-2rb oa-2sh oa-2tm oa-2wc oa-2yi oa-2yj oa-3pj oa-3yp oa-5bg oa-5by oa-5dx oa-5hg oa-5xg oa-7hl oa-4aw oa-4bd oa-4go oh-6amu oh-6bdl oh-fil oz-1mn oz-2aq oz-3au oz-4am sa-af1 sa-fa3 sb-1af sb-1ah sb-1ao sb-1ar sb-1aw sb-1br sb-1ck sb-1cl sb-1ia sb-1ib sb-1ic sb-2aw sb-2ay sb-2ba sb-7aa sb-sqax se-1fg ss-2bn su-1br su-1oa su-1pe su-2ak xei-1fp xen-oqq xen-osq xnc-cr1o xnc-vde xnc-voq xoa-5ma.

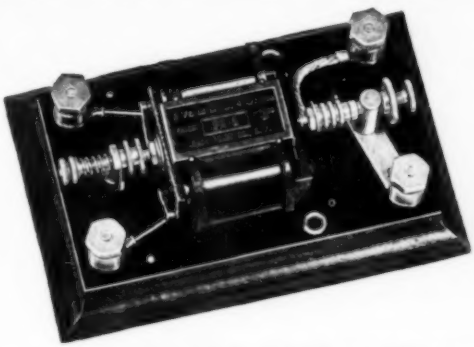
**4OO, A. K. Edgerton, 18-40th St. So., St. Petersburg, Fla.**

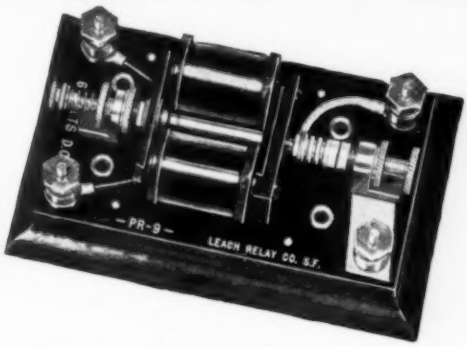
(Heard between Nov. 23 and Dec. 23, 1927)

7aae 7afo 7agj 7ali 7gj 7rs 7adg oa-2dy oa-3jk oa-5by ef-8ba ef-8cp ef-8ct ef-8ul ek-4xy ep-1aa ep-3tm ep-3uz es-1co fo-a4l nc-1dj nc-2am nc-2ew nc-3el nc-4du nc-4gi ne-8ea nm-1rl nm-9a nn-1nic nq-2kp oa-5dx oa-5hg oa-5rj oa-5wh oa-7ch oa-7hl oo-bam oz-1an oz-1ap oz-fe oz-2ab oz-2ay oz-2dy oz-2go oz-3aj oz-3au oz-4am sb-1aj sb-1ak sb-1ao sb-1aw sb-1ea sb-1cn sb-1ib sb-2ah sb-2ah sb-2aj sb-2ax su-2ak sv-1xc.

**Ef-RO91, C. Conte, 24, Allee Du Rocher, Clichy-sous-Bois, (S-et-O) France**

1aap 1abd 1ach 1acu 1afl 1ahx 1ajx 1aqp 1atv 1avy 1axa 1axx 1bae 1bdo 1bdq 1bke 1bln 1bnh 1bns 1bdq 1bsd 1bux 1chg 1eje 1cmf 1enz 1epf 1ere 1fl 1fs 1gi 1ja 1jc 1kf 1mo 1mv 1nv 1ai 1ue 1rf 1vs 1vz 1xi 1xv 2adv 2aed 2afr 2afv 2agb 2agn 2ag 2ali 2alu 2amf 2amh 2ang 2aoj 2aqu 2atq 2ayj 2bdl 2be 2bms 2bv 2cbe 2ci 2cmw 2ctm 2cwm 2cuq 2exl 2dh 2ie 2iz 2jp 2kr 2kx 2la 2nm 2pv 2qs 2sz 2tp 2tr 2uo 2rs 3adp 3afw 3aib 3aim 3aiv 3ag 3ahp 3aks 3ali 3amx 3bjy 3blp 3bms 3bmz 3bnu 3bqz 3cab 3cc 3ceb 3ckl 3gi 3jm 3mv 3nr 3ow 3pf 3pr 3qt 3qw 3ss 3sz 3ua 3wj 4acn 4ei 4fu 4gy 4jd 4jw 4ll 4lp 4oc 4oo 4qz 4rn 4vr 4we 4wo 5abi 5acl 5afb 5aqe 5as 5atv 5fu 5kc 5uk 5yb 8acu 8adg 8adm 8agv 8air 8ajt 8alu 8amu 8amx 8ank 8apt 8aro 8avl 8avp 8awu 8bau 8baz 8bfp 8bjh 8box 8bxh 8byn 8ceb 8ceo 8edt 8ejb 8cjw 8cli 8epc 8evd 8exd 8ddk 8ded 8dct 8dod 8dsa 8es 8eq 8ew 8im 8ipt 8jj 8qb 8ru 8uy 8vd 8xd 8xe 8wp 9aid 9aqa 9aqj 9avp 9bdg 9bed 9bz 9cbd 9ejh 9ejm 9cjw 9cnc 9cpn 9cpr 9crj 9cv 9cx 9ddn 9dpj 9dr 9eecx 9ef 9efo 9efz 9eld 9emj 9eps 9fo 9lf 9nr 9uu 9ux 9uz wnp nc-1br nc-3zb nq-2la.






## *NEW RELAYS for your Transmitter*

PR-5

Operates on 6 volts D.C. adjustable to all positions. ¼" pure silver contacts. Lacquered brass finish. 3 x 5¼" x ¼" Bakelite base. Maple sub-base. Recommended for 250 watts or less.

PRICE $9.00

PR-9

Operates on 6 volts D.C. Adjustable to all positions. 3/8" pure silver contacts. Highly polished nickel finish. Engraved Bakelite base. Maple sub-base. Recommended for 250 watts or over.

PRICE $12.00

*THESE RELAYS ARE EXTREMELY FAST. THEY DO NOT LAG NOR DRAG.*
*MADE BY MAKERS OF THE FAMOUS "LEACH BREAK-IN RELAY"*

**LEACH RELAY COMPANY**

**693 MISSION STREET** **SAN FRANCISCO, CALIFORNIA**

## *Why Experiment?*

The widespread use of AEROVOX condensers by more than 200 set manufacturers — and the use of AEROVOX PYROHM power resistances by more than 20 eliminator manufacturers — is conclusive evidence of their

*reliability-accuracy-worthiness.*

YOU cannot overlook these facts. . . . The selection of AEROVOX products by so many of the foremost radio engineers of this country is PROOF that these products will serve you faithfully and efficiently.,

AEROVOX

*"Built Better"*

70 Washington St., Brooklyn, N. Y.

# Quality Amateur Apparatus

***En all Radio Laboratory Products are Quality Built for Transmission and Reception.***

We supply Transmitters for Radiophone or C. W. Receivers of the Three to Eight Tube Designs Ranging in Price from $38.00 to $150.00. Kit and Blue Print Service. Wavelength Range from 15 to 210 Meters, with Guaranteed Smooth Oscillation Control. We also make and supply Wavemeters, Inductances (Transmitter and Receiver), Choke Coils, Transformers, etc., Distributors for nationally known Microphones, Transformers, Plate Reactors, Motor Generators, etc.

We construct to order, employing your parts if desired. Prices on Application. Write for Bulletin 66-E.

## ENSALL RADIO LABORATORY

**1208 Grandview Ave. Warren, Ohio**

Amateur Broadcast Marine

***"Pioneer Builders of Short Wave Apparatus"***



# MASTER THE CODE

**QUICKLY AT HOME**

Wireless or Morse with The

**TELEPLEX**

**Code Instructor**

No better method for self-instruction exists. *Quick-Easy - Thorough.* Endorsed by U. S. Navy and leading Technical and Telegraph Schools. The only instrument that *REPRODUCES actual sending* of expert operators. Sends messages, radiograms, etc. Any speed

***Complete course (6 tapes) FREE. 30 times as many words*** as any other instrument. Tapes cannot be memorized. Last indefinitely. Avail yourself of the TELEPLEX for a quick mastery of the code. Write for booklet RL.

*Canadian Representative Wanted*

**TELEPLEX CO., 76 Cortlandt St., New York**



# Dubilier

## CONDENSERS

**DUBILIER CONDENSER CORP.**

**4377 Bronx Blvd. New York, N. Y.**


**M. Thomassin, 16 Bould St., Jacques, Paris, France**
(Heard during November)

1abd 1acm 1afl 1age 1ahx 1akm 1aq 1aqt 1asi 1avj 1awm 1axa 1bdq 1bhs 1bkp 1bl 1bnh 1bq 1bvl 1chg 1ceo 1cjc 1ck 1cmp 1cmx 1cnz 1di 1ej 1ga 1ic 1mo 1no 1ql 1qp 1rf 1si 1vc 1vz 1xv 1yd 2aad 2abe 2abp 2aes 2afr 2afv 2agb 2age 2ags 2agw 2ahg 2aib 2ali 2alu 2alv 2ama 2amh 2ang 2aqu 2art 2ase 2asg 2atq 2atr 2aun 2avr 2avw 2ayj 2bad 2bbx 2bch 2bdc 2bi 2crb 2ctm 2fc 2ih 2iz 2jc 2lh 2ol 2sm 2tg 2tp 2tr 2vd 2vo 3acf 3adi 3aib 3alq 3amx 3cbt 3dh 3lq 3pf 3qe 3qm 3qw 3sh 3sj 4ar 4ei 4gy 4hh 4mi 4nu 4oc 4qb 4rn 5abi 5acl 5afb 5kg 5ql 5yb 8acu 8adm 8aip 8aks 8apt 8aue 8axa 8baz 8bek 8bm 8box 9cta 9ctn 9cqo 9cxc 9cxd 9dcm 9dsa 9dqz 8es 8ex 8ipt 8ro 8vd 8xe 8wa 9ayr 9bq 9crd 9crj 9cn 9ddn 9eds 9efo 9fs 9uz.

**Frank S. Adams, 1f0 Ivor Road, Spark Hill, Birmingham, England**

(Heard at Baghaad, Iraq, between Aug. and Nov.)
1abd 1bvl 2ag 2aiu 2aun 2dh 2rs 2uo 4acy 4qz 1abz 1ar 1aw 1ced 1md 2nh 2cag 3kr 4uni 6die 7dh 7xu 9dad ea-cm ea-kl ea-ku ea-wy ed-7eth ed-7lk ed-7jo ef-8ju ef-8nn ef-8uga ef-8et eg-2gv eg-2od eg-6wn ei-1fo ei-1za ek-4aap ek-4abr er-5ab fq-1pm nc-1ar.

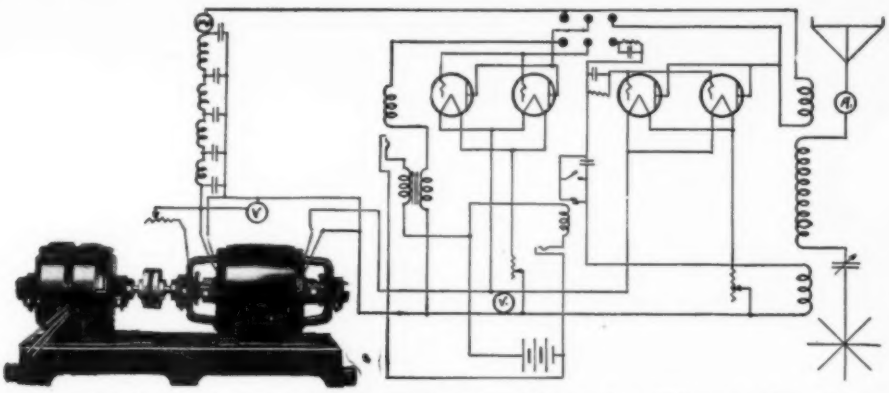
**eg2BQH, G. G. E. Bennett, 26 Blenheim Park Rd., Croydon, Surrey, Eng.**

(20-meters)

1aba 1abx 1acm 1aiq 1ajm 1amc 1aqt 1awe 1bbm 1bhs 1bjk 1bkv 1bqs 1bux 1bw 1byv 1caw 1ccz 1cmf 1cmx 1dl 1eo 1fl 1ip 1kl 1pm 1rd 1rf 1ry 1sw 1sz 1uz 1wz 1xr 2agn 2aiu 2aol 2ate 2atr 2aul 2bac 2bcb 2bg 2bui 2dr 2gp 2nm 2ox 2tp 2va 2xad 3ade 3bzg 3mv 3nz 3qe 4km 4qy 6xi 7ek 8adg 8ago 8ahc 8axa 8bct 2bfg 8cjw 8cpq 8cug 8djv 8kr 9adn 9bzi 9cei 9dfz kel kzet waj wbu wik wiz wgt wll wnp wnu wqq nc-1ap nc-1ar nc-1br nc-1dm nc-2al nc-3dn nc-3fc nc-vde ne-8af no-2sm sl-hjg sb-1aw oa-2no od-and od-anf od-anh od-pkh fc-2vo fm-8mb fp-crhb af-1b af-hza1.

(40-meters)

1aao 1aep 1afw 1ag 1agc 1ahc 1akm 1amu 1anz 1aqi 1aqp 1aqt 1asf 1atx 1auk 1avj 1axx 1ayl 1azw 1bak 1bhs 1bi 1bqb 1br 1caa 1cbh 1cd 1cjc 1cnz 1fl 1ic 1ig 1ka 1kh 1kl 1mo 1nq 1og 1ql 1rd 1si 1td 1uz 1vs 1xi 1xv 1yb 1zw 2abp 2abt 2ach 2adl 2aes 2ag 2agb 2agp 2agu 2ah 2ahb 2ahi 2aib 2ajb 2akv 2alu 2amf 2ang 2anp 2apd 2api 2aq 2aqg 2aqu 2arb 2ase 2ate 2atx 2aua 2auh 2aul 2aun 2aut 2avl 2awq 2ayj 2azk 2bao 2bbc 2bbj 2bco 2bcv 2bcw 2bdk 2bi 2bm 2boi 2bry 2bs 2byg 2ca 2cc 2cep 2crb 2crn 2cty 2cuq 2cyx 2dp 2ev 2fa 2fw 2fx 2hh 2hq 2ie 2ih 2iz 2kg 2kl 2oe 2pv 2qh 2sb 2sz 2ub 2uo 2vm 2wz 2xaf 2xg 3abg 3acf 3aeb 3aed 3afw 3aim 3aks 3ali 3amx 3apn 3auv 3auw 3bbw 3bei 3bms 3bqz 3bad 3cbt 3chg 3ex 3ez 3gb 3gr 3lq 3mb 3mv 3pr 3qe 3ss 3sz 4aba 4act 4acv 4acz 4adb 4aom 4ei 4fu 4gl 4iz 4jd 4jw 4ll 4mi 4ob 4oc 4on 4pa 4rm 4rn 4rq 4si 4uo 4za 5ahp 5atf 5ayl 5eb 5kc 5ki 5mx 5oa 5or 5qj 5rg 5uk 5vx 6adm 6eww 6czc 7sf 8afu 8agi 8aip 8ajx 8akv 8anx 8apy 8asg 8auc 8bad 8bau 8bhz 8bjb 8bjx 8bki 8bum 8bwe 8bwz 8byn 8cae 8cau 8chl 8cjw 8cpe 8cqa 8crq 8cul 8cvd 8cxi 8dgl 8dhx 8djf 8dkk 8dnf 8eq 8es 8ex 8ey 8li 8rh 8rt 8sh 8sx 8ay 8ua 8uy 8vd 8vx 8zi 8zzc 9abu 9akt 9amg 9anc 9anz 9aol 9aqt 9auu 9axo 9bat 9baz 9beq 9bgq 9bjw 9bmm 9bnp 8bzi 9cb 9cfy 9cks 9cmx 9cpq 9crd 9crj 9dae 9dbj 9dku 9dli 9dma 9dpj 9dr 9dso 9dte 9ebo 9ebp 9ecb 9eld 9fa 9lz 9oo 9dx 9pb 9uq 9wr 9xi kel naa nss wiz nc-1bi nc-1br nc-3bt nc-9bz ne-8ae np-naj nq-2ac nq-2ef nr-2fg sa-da9 sa-db2 sa-en8 sa-lp1 sb-1ah sb-1aj sb-1ak sb-1ao sb-1aq sb-1ar sb-1aw sb-1ax sb-1br sb-1cg sb-1sm sb-1ic sb-1jb sb-2ad sb-2aj sb-2ak sb-2ar sb-2ay sb-6qa sb-pth sb-ptq sb-pty sb-snni sb-sqbw sc-2ab sc-3ag ss-2bn su-1bc su-1oa su-2al sv-1xc oa-2ch oa-2gw oa-2jw oa-2no oa-2rc oa-2sh oa-2wb oa-3bq oa-3vp oa-3wm oa-4bd oa-4go oa-5ax oa-5mb oa-5wh oa-7cw oa-7gh oa-7hl oa-7pf od-and oz-1ao oz-2ab oz-2al oz-2at oz-2bg oz-2bp oz-2ga oz-2gc oz-2xa oz-3ai oz-3ap oz-3ar oz-3au oz-4aa oz-4ac oz-4ae oz-4am ar-8fbh fm-8ay fm-8ma fm-8mb fm-8rit fm-8vx.



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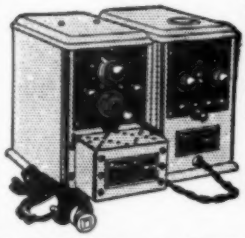

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1adm 1ahi 1ajm 1aot 1aoh 1alr 1azw 1asi 1aep 1aff 1akz 1ajh 1ach 1apv 1aal 1anv 1aba 1awe 1ag 1rbd 1awm 1ahx 1amu 1agw 1arx 1aq 1axx 1akm 1afl 1att 1ang 1aaw 1axn 1bcw 1bjk 1bux 1bbm 1bql 1bcn 1bgc 1beb 1bgt 1bkt 1bl 1bqs 1bw 1bed 1bbo 1bvb 1cio 1cmf 1cue 1ctu 1cpb 1cjh 1ccz 1cxy 1cmp 1ck 1cnz 1cra 1cdi 1dm 1dl 1di 1fl 1ff 1fs 1gc 1gh 1ia 1ic 1ii 1ka 1kc 1kl 1lv 1lj 1mo 1no 1ow 1qi 1rd 1rw 1sz 1uw 1ue 1uz 1vw 1vc 1xi 1xv 1zl 2afv 2apa 2ags 2ahm 2alu 2aoj 2aef 2asc 2aib 2ada 2aue 2awq 2ahi 2avw 2ayj 2amj 2agn 2atr 2atq 2ass 2abe 2agp 2awi 2arb 2alu 2ag 2abf 2aev 2amh 2ard 2ase 2adb 2agb 2awf 2aqg 2anp 2awk 2azy 2bbe 2bdk 2bmr 2bda 2bnr 2bck 2bad 2bum 2buy 2bac 2bui 2bdc 2bec 2bco 2bdh 2bbm 2cuz 2cns 2cwm 2cyx 2crb 2cuq 2cjb 2cx 2sa 2cjd 2dh 2gp 2hv 2hq 2ih 2jn 2md 2ow 2or 2px 2pq 2pv 2rs 2sj 2tp 2tw 2uo 3ag 3aks 3ajx 3aim 3aqe 3ahr 3adl 3acm 3aib 3aef 3bwt 3btq 4acn 4bu 4be 4cj 4fv 4hx 4ix 4it 4ic 4jw 4oh 4qz 4qb 4rq 4rn 4sq 4tu 4wh 4we 4xe 6mu 8aly 8afg 8alu 8axn 8azg 8aj 8axa 8atv 8arg 8akg 8azt 8adm 8asf 8agi 8ayv 8ajt 8axz 8bni 8bas 8bwa 8ben 8bwz 8cmb 8cvs 8cmg 8ces 8cae 8cln 8cdf 8ces 8cjv 8cjo 8dsy 8dtp 8djp 8dod 8dcm 8dne 8doa 8djv 8dgp 8dae 8eh 8es 8li 8uy 8vx 8xe 8zc 9akn 9afa 9ara 9acl 9bpl 9bjw 9cei 9crd 9dbi 9eg 9ein 9edb.

**Miss B. Dunn, Stock, Essex, England**
**(Heard during November)**

1acm 1amn 1aur 1azd 1bke 1on 1opb 1di 1ke 1zz 2aad 2afr 2agl 2agn 2alu 2amh 2ase 2bdc 2bum 2czr 2md 2rs 2xs 2auv 3chg 3gf 3pf 3qe 3qw 3sj 4we 8cer 8dne 8li 9beq sb-1ca od-anc od-anf ed-7ahl ed-7bb ed-7bx ed-7fr ed-7hp ed-7jo ed-7mt ed-7ng ed-7zg ed-7zm ed-oxg ed-oxz eg-axa eh-9xc ej-7qq el-1a el-1alg el-1als em-smrt em-smss em-smua em-smuf em-sab em-sdk em-sfy ep-1aa ep-1ae ep-1ag ep-1be ep-1bk ep-3am es-2hb eu-wt eu-15ra ne-xom ai-vwx fe-suc fe-suc2 fm-8rit fo-a9a fv-oodb agj dnse eex28 gbh gbi ocej pad pcmm pcpp rlj sjg vzdk.

**el-1CR, Ing. Vincenzo Quasimodo, Piarza Tommaseo 16, Gorizia, Italy**

1mv 1ben 1aff 1nv 1py 1byv 1ry 1awe 1vw 1awy 1bzi 1xv 1zz 1cpb 1da 1bhm 1adm 1bux 1mw 1akz 1ajm 1bw 1biv 1bcn 1aao 1axx 1ccz 1aiz 1ia 1bgs 1zl 1bke 1cmf 1dl 1nyz 1alr 1aqt 1ii 1asu 1fd 1cjh 1nf 1beb 1kl 1bjk 1kj 1sz 1aq 1als 2jn 2agn 2avb 2je 2sg 2bbc 2asr 2gp 2aef 2tr 2ch 2cjd 2avb 2bvd 2alm 2amd 2ane 2ahg 2bac 2avz 2ahm 2nm 2azk 2aib 2abf 2atq 2bad 3aed 3age 3tn 3nr 3jv 3nb 3add 3xan 3ql 3jq 3jx 3czc 3mw 3bgo 3qe 3mv 3kj 3caq 3amx 4px 4rn 4io 4lp 4rm 4lk 4tu 5avs 5la 5agq 5bf 5mx 5afb 5yb 6dcq 6ahn 6agr 8btr 8aly 8adg 8box 8cil 8ve 8dhx 8clp 8bev 8dod 8aja 8bto 8odb 8dia 8bsr 8atv 8cfr 8bod 8ddn 8dld 8ccs 8aj 8acz 8ben 8dgx 8che 8ciq 8btr 9bay 9db 9ark 9cvy 9jk 9cmv 9cd 9adn 9cn 9aic 9cwa 9bzi 9awi 9blw 9ef 9dke 9afa 9dws nc-3jm nc-2al nc-1br nc-2be nc-1ap nc-3ag nc-1bt nc-1dm nc-1ar nc-1co nc-2fo nf-bat ni-tfhb nj-2pz nm-1bw mm-gx np-4sa nq-2cf nq-5ry ns-3jg ns-2gx nx-1xl nr-2fg nr-cto ne-8rg ne-8ae nz-5er sb-2as sb-1ax sb-1ad sb-1ac sb-2ar sb-1ib sb-2ax sb-1nh sb-1ay sb-2ad sb-1ic sb-1br sb-7ab sb-1cg sb-2ag sb-1aw sb-2ay sb-1ao sb-1ca su-2ak su-1cd su-1bc su-1on su-3ah sa-1pu sa-cb8 sa-de3 sa-c6f sc-2ah sc-2ar sv-1xc oa-7cw oa-3wm oa-3am oa-3bd oa-7gh oa-2tm oa-2jw oa-2yi oa-7hl oa-3vj oa-2sh oa-2cm oa-2no oa-5bg oa-3bq oa-7bq oa-2ro oa-3jk oa-3ga oa-3oe oz-2bg oz-2br oz-2ga oz-3ap oz-1ax oz-2gx oz-4ae oz-3aj oz-3ar oz-2al oz-1ao oz-2ac oz-2bp oz-4aa oz-1fb oz-2ne oz-4am fq-pm fo-a9a ai-2kx.

**ei-1ER, Ing. Mario Santangeli, S. Rufemia 19, Milano, Italy**

**(Heard during October and November)**

1abd 1als 1aow 1aq 1asf 1awx 1bdq 1bed 1bnh 1bns 1bqd 1bxl 1clv 1cnz 1kw 1jq 1qo 2ach 2afr 2agb 2ahi 2ahr 2ali 2alu 2awm 2bdh 2bfj 2bgb 2bgt 2bi 2bjy 2bud 2bvd 2bzf 2cd 2cwm 2fp 2kl 2lv 2ow 2ps 2rd 3adl 3aed 3ah 3anh 3apn 3aqs 3bfw 3bjw 3bnu 3buv 3cm 3cn 3gb 3pv 3qp 3wm 3xw 4nc 4acn 4acv 4anc 4cy 4km 4kw 4lu 4nq 4oo 4qe 4uo 4xe 5kd 5ql 5rg 8abx 8abz 8adq 8aff 8agi 8agw 8ajt 8aqn 8bbg 8bec 8bdt 8bek 8bww 8cfv 8ckc 8cjb 8cnt 8dke 8dar 8ht 8jj 8vd 9beq 9cfd 9cjw 9cn 9crd 9dck 9dkc 9eb 9ell 9eqa 9fs 9jw 9rxh na-1yb ne-8ae nc-1bh nc-9bz oa-2hm oa-2no oa-2ro oa-2tm oa-2yj oa-5ky oa-3on oa-5ry oz-1ap oz-2ab oz-2at oz-2ay oz-axa oz-3au su-2an fm-8mt fm-8at fm-8rit aqe arcx 2xf crha gzc fm fy nwq oist qrb ogd sqbw tru.

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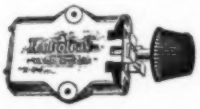

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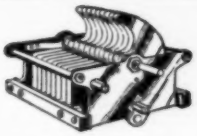

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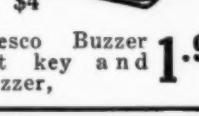

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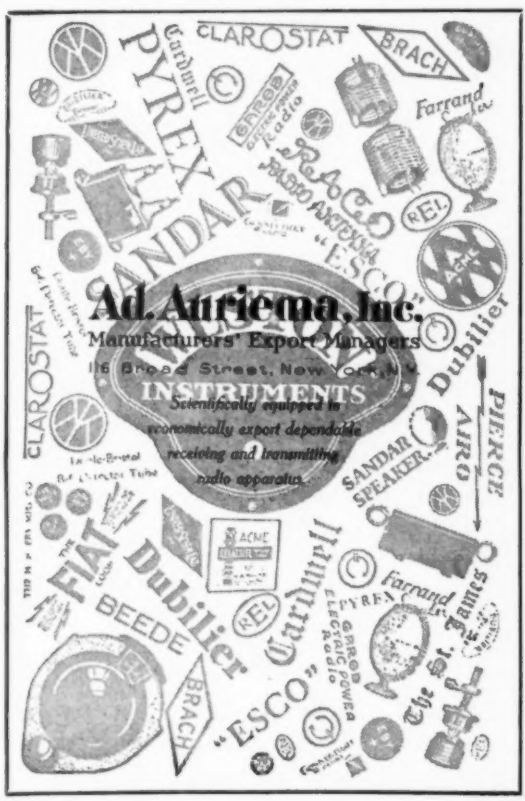




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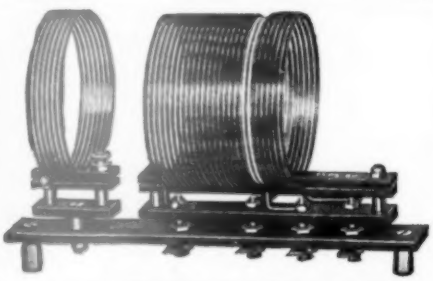

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(Heard during November)

(20 meters)

1aep 1ajm 1awe 1bwm 1fl 1ho 1ne 1rw 1sz 2aib 2alw 2aol 2ard 2bui 2gp 2nm 2md 2tp 2vp 2vs 3adm 3aib 3bsd 3fw 3jm 3ku 3ra 3tn 3wm 5aav 5acl 5avs 5ql 5tp 6bjh 6dfs 6cmy 7fl 8adn 8agy 8akx 8arb 8avb 8axa 8axd 8ayo 8bag 8baz 8bkc 8cer 8ccw 8c8l 8den 8djv 8dpo 8dip 8hw 8re 8ut 8wb 9afa 9agy 9ara 9asc 9auu 9bha 9bmd 9bnd 9bpx 9bsa 9bza 9civ 9cjw 9cko 9cmv 9cu 9crd 9cuh 9cvy 9dax 9dbj 9dbm 9dij 9dll 9dmb 9drd 9dwe 9dws 9ecz 9enu 9ef 9enu 9emn 9ln 9nm 9ax nc-2al nc-2be nc-3bt nc-3gg nc-3gn nc-4fv sb-1aa sb-2ag nm-9a wnp uc uf hjg cto ocdl.

(40 meters)

1cio 1etl 1vt 2bco 2bdj 2ctn 2ih 2sh 2xd 3amx 6akw 6avj 6bjh 6brd 6bzn 6czm 6dje 6ju 6xi eg-5ls eg-6yq ef-8cp ef-8dmf ef-8fd ef-8fg ef-8xo fd-8k es-1co ei-1er nc-3gn nc-4bc nc-4bl nc-4ey nc-4fv sb-1aw sb-1ah sb-cb8 nr-2fg fm-8st ardi arcx vlb nm-1r ns-3jg kzet xcl oa-2dy oa-2jy oa-2uk oa-2xi oa-3gr oa-3ot oa-4nw oa-5mb oa-5hg oz-2ab oz-2ay oz-2bp oz-2kw oz-3af oz-3au oz-4am.

**S. S. Liberty Bell, KUJX, calls heard during November, 1927.**

From Port de Bouc, France, to Gibraltar (40 meters)

1ic 1td 1ve 1xv 1zz 1abm 1acm 1avj 1awm 1azd 1bed 1boq 1cbh 1com 1ctp 2bs 2fx 2gp 2hr 2hv 2iz 2mb 2md 2or 2pv 2qu 2sg 2sz 2tr 2uo 2vm 2adl 2aed 2agb 2agp 2ags 2ajb 2alu 2amj 2anp 2aoj 2aqo 2aqu 2aul 2brb 2bzf 2cwm 3ag 3am 3cf 3dh 3lm 3qe 3qp 3sz 3ua 3zw 3aib 4cu 4ei 4fx 4kw 4lu 4oh 4rn 4abz 4acn 4acz 5jf 5jy 5ql 5rg 5nw 5yb 5auz 8ex 8jj 8on 8pl 8vd 8xe 8abx 8adg 8adm 8agi 8agk 8ajv 8akv 8aly 8ank 8awu 8ben 8bpd 8bsu 8bwr 8ccm 8cer 8ccs 8cpc 8cqi 8ctd 8ddk 8dsa 9dr 9gj 9mn 9ra 9uq 9abu 9acu 9anz 9ars 9beq 9beu 9bpb 9cmj 9cph 9crj 9crd 9cvy 9dbj 9des 9dkc 9efz 9eky 9eps ea-fo ea-kl ef-8im ei-1bd fm-8vx fm-8rit nc-1br, nc-2be nc-8ae nn-1nic.

From Gibraltar to Madeira Islands (40 meters)

1fl 1po 1wv 1zs 1asf 1avj 1bed 1bhm 1bvl 1chg 1clv 2ag 2bc 2bi 2dh 2fj 2ie 2md 2tr 2uo 2vp 2afr 2ajb 2ali 2alu 2aun 2awf 2bad 2bfw 2bsk 2cei 2cjd 2ctm 2cua 2cuf 2cuq 2cxl 3kp 3ld 3pr 3rn 3wc 3wj 3adl 3afl 3afw 3amx 3awf 3bnu 3bqz 3caq 3cdg 4fv 4oc 4rn 4rp 4tn 5kl 5acl 5ako 6am 6ec 8ez 8gk 8on 8ru 8vd 8vn 8agi 8ajt 8alu 8amt 8bsu 8buj 8ccm 8cer 8ceo 8cgf 8cjx 8ckc 8cmo 8ctd 8ded 8dqb 8dsi 9cn 9ef 9fo 9mn 9nr 9ra 9wr 9xi 9ajr 9bed 9biz 9bmm 9bxi 9cjw 9dbw 9des 9dkc 9efz ef-8cp ef-8btr ef-8gdb ek-4dba nc-1ac nc-1ar nc-3dp.

## The South Dakota Convention

*(Continued from Page 55)*

gave a very fine talk on working the different wave bands and seems to delight in keeping in close touch with the members of his division.

Treasurer Hebert, of the A.R.R.L. Headquarters, talked on the International Radiotelegraphic Convention, explaining some of the complexities, and made us realize the benefit of thorough organization.

With the awarding of the prizes for all the contests and hamfesting afterwards the convention closed in the wee hours of Friday morning with a rousing cheer to the Y.M.C.A. Radio Club for so successfully conducting the convention.

—*A. A. H.*